Series 1931 Number 27

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
Indiana County, Pennsylvania

By

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Bureau of Chemistry and Soils

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CONTENTS

	Page
County surveyed	1
Climate	4
Agricultural history and statistics	5
Soils and crops	9
Well-drained soils	11
Westmoreland group	12
Westmoreland silt loam	12
Westmoreland shaly silt loam	13
Westmoreland gravelly silt loam	14
Westmoreland gravelly silt loam, steep phase	15
Brooke silty clay loam	15
Belmont silt loam	16
Upshur silt loam	17
Upshur silt loam, steep phase	18
Rayne group	19
Rayne silt loam	20
Rayne gravelly silt loam	21
Rayne stony silt loam	21
Rayne shaly silt loam	21
Gilpin gravelly silt loam	22
Gilpin gravelly silt loam, steep phase	23
Gilpin stony loam	24
Gilpin stony loam, steep phase	24
Gilpin gravelly sandy loam	24
Gilpin shaly silt loam	25
Gilpin shaly silt loam, steep phase	26
Dekalb group	26
Clymer gravelly silt loam	27
Clymer silt loam	28
Clymer shaly silt loam	28
Clymer stony silt loam	29
Dekalb gravelly silt loam	29
Dekalb gravelly silt loam, steep phase	30
Soils and crops—Continued.	
Well-drained soils—Continued.	
Dekalb group—Continued.	
Dekalb gravelly sandy loam	30
Dekalb shaly silt loam	31
Dekalb shaly silt loam, steep phase	31
Dekalb stony loam	32
Dekalb stony silt loam	32
Dekalb stony silt loam, steep phase	32
Leetonia gravelly sandy loam	32
Leetonia gravelly sandy loam, steep phase	33
Leetonia stony sandy loam	33
Leetonia stony sandy loam, steep phase	33
Rough stony land	34
Imperfectly drained soils	34
Cookport silt loam	34
Cookport silt loam, poorly drained phase	35
Cavode silt loam	36
Ernest silt loam	37
Ernest silt loam, calcareous phase	37
Monongahela silt loam	38
Pope silt loam	39
Pope loam	40
Poorly drained soils	40
Lickdale silt loam	40
Robertsville silt loam	41
Atkins silt loam	41
Alluvial soils, undifferentiated	42
Agricultural methods and management	42
Soils and their interpretation	46
Summary	51
Map.	

SOIL SURVEY OF INDIANA COUNTY, PENNSYLVANIA

By R. T. AVON BURKE, in Charge, and C. S. SIMMONS, United States Department of Agriculture, and J. L. HOSTERMAN, RICHARD MARSHALL, and C. H. ATKINSON, Pennsylvania State College

COUNTY SURVEYED

Indiana County is situated in the west-central part of Pennsylvania (fig. 1). Indiana, the county seat, is about 65 miles by highway northeast of Pittsburgh and about 40 miles northwest of Johnstown. The county is irregular in outline and includes a total area of 829 square miles, or 530,560 acres. The southern boundary is formed by Conemaugh and Kiskiminetas Rivers.

This county is situated in the physiographic division known as the Allegheny Plateau, although it lies some distance west of the Allegheny Front and is included in the eastern coal fields. Physiographically the county may be divided into two plains, an upper and a lower, separated by the escarpment of Chestnut Ridge, which is a conspicuous feature in the central and southern parts. The upper plain lies east of this line; and the lower, west. In the upper plain the uplands range in elevation from 1,500 to 1,900 feet above sea level, with a maximum elevation of 2,080 feet near Pineton. Chestnut and Dias Ridges are outstanding features of this division, and in the southeastern part of the county they are separated by Brush Creek Valley, which consists of gently rolling country with a minimum elevation about 500 feet less than the ridges. Both ridges become narrower as they extend southwestward and the relief is mountainous, but toward the north they broaden, merge with each other, and have distinct plateaulike characteristics, with broad flats in places.

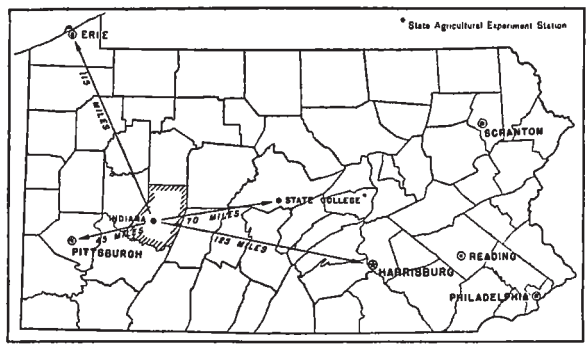

FIGURE 1.—Sketch map showing location of Indiana County, Pa.

The general elevation of the lower, or western, plain ranges from 1,200 to 1,500 feet above sea level. A few knobs, hills, and ridges attain elevations of 1,600 or more feet. The elevation of the ridge tops, which are remnants of the old plain, in general is greater in the eastern and northern parts and lower in the southern part. The tops present an even skyline, with nearly equal elevations. The land

in general might be described as rather smooth rolling and hilly country, consisting of ridges, broad divides, flat saddles, and rounded hills.

The upper and lower plains divisions merge with each other in the northern part of the county, and the old plain features of both divisions have largely been obliterated or degraded by the ramifications of a well-developed drainage system. Erosion in general has trenched the land in a northeast-southwest or westerly direction. It is characterized by a series of longitudinal troughs and ridges which become less outstanding toward the western boundary and more conspicuous toward the eastern. In general from east to west the elevation of each successive ridge is less, although, in places in the northern half of the county, the elevation is generally lower and hills rise conspicuously above the surrounding country, the outstanding elevations including Kunkle, Warner, and Russell Hills. In the eastern part, valleys have been cut to a depth ranging from 300 to 500 feet below the uplands, or to a base level between 1,300 and 1,400 feet. Here the western slopes of the larger stream valleys are steep and in many places rough. This part of the county is not so generally dissected as the western part, but most of the streams are more active and have developed narrow and more gorgelike channels, especially where Blacklick Creek, Conemaugh River, and Yellow Creek traverse Chestnut and Dias Ridges. As these streams extend farther west, bottoms and terraces are more consistently developed along their courses. In the western-plain division, nearly all the streams have developed bottoms or terraces, or both, which range from bottoms a few feet wide to terraces a mile or more wide. Kiskiminetas River leaves the county at an elevation of about 834 feet above sea level; Crooked Creek, 980 feet; Plum Creek, 1,060 feet; and Mahoning Creek, 1,100 feet, ranging from 300 to 400 feet below the general level of the uplands of the western-plain division. With the exception of the slopes along Mahoning Creek and Two Lick Creek, which are steep and rough in places, the land along most of the streams in this division is, in general, gently sloping.

Indiana County, in general, may be described as open country, as most of the present tree and brush growth is restricted to the rougher and more inaccessible parts, to the steep hillsides, and to the more shallow and stony land. The original forest in the eastern part of the county consisted largely of white pine, hemlock, chestnut, bur oak, birch, cherry, and maple; and in the western part the forest growth was white, red, black, and chestnut oaks, hickory, poplar, sugar maple, walnut, cherry, locust, birch, cucumbertree, and dogwood. The present forest is largely second growth. The 1930 census reports 43,738 acres in woodland not pastured and 23,491 acres in woodland pasture. Lumbering in early times was the dominant industry, and some large tracts of timber still remain along Yellow Creek, Blacklick Creek, and Mahoning Creek. Most of the trees now being cut are used for mine timbers, and mine props are cut by many farmers in sections where coal mining is active.

In general the forested areas support a dense growth of trees. In most places in the eastern part of the county, the undergrowth is heavy and consists of laurel, huckleberry, dewberry, goldenrod, blackberry, groundpine, and wintergreen. Where the timber has been removed and on patches formerly farmed but now abandoned,

moss and poverty grass are common, and rhododendron grows on many of the lower slopes of the deep narrow V-shaped valleys. In the western part, the forest growth is more open, and the undergrowth consists largely of young sprouts of sassafras and dogwood, together with grapevines, blackberries, dewberries, and myrrh. Nearly all the open spots support a cover of timothy, redtop, poverty grass, ticklegrass, and quackgrass. Kentucky bluegrass is conspicuous in the southwestern part.

Drainage is effected by the Allegheny and Susquehanna River systems. The greater part goes into Allegheny River through Kiskiminetas and Conemaugh Rivers and Mahoning Creek. Susquehanna River receives the drainage water from a very small section of the northeastern part of the county through streams tributary to West Branch Susquehanna River. The drainage, with some exceptions, may be described as matured and dendritic, with small streams and branches extending to all parts of the county and to almost every farm. In the broader and flatter areas in the eastern and northern parts, streams are not so numerous, but artificial drainage is necessary only in a few places.

Indiana County was created by act of the assembly in 1803, from parts of Lycoming and Westmoreland Counties. It derived its name from its first denizens, the Indians. The early white settlers, who were of Scotch-Irish descent, came from eastern counties of the State and the Cumberland Valley. They were followed later by Germans and Welsh. The present inhabitants, who number 75,395, are largely descendants of these early pioneers. With the development of the coal industry in recent years, many emigrants from foreign lands have come to the county, particularly Italian, Polish, Austrian, and Slavish people.

The principal towns are Indiana, the county seat, with a population of 9,569; Blairsville, with 5,296; Clymer; and Saltsburg; and many small villages and hamlets are scattered throughout the county.

Transportation facilities are excellent over four railroad lines which serve nearly all sections. The Pennsylvania Railroad, with several branches, serves the southern and southeastern parts and part of the northeastern corner. The New York Central reaches the east-central part. The Buffalo, Rochester & Pittsburgh serves the central and western parts, and the Buffalo & Susquehanna serves several communities in the north-central part. Both of these lines are parts of the Baltimore and Ohio system.

Indiana County has excellent markets in a number of towns within its boundaries, and the transportation facilities afforded by the four railroad lines and freight truck lines enable produce to be quickly dispatched to Pittsburgh, Johnstown, and Punxsutawney, and from these points distributed to remote markets.

There is an excellent system of concrete and macadam highways which traverse all sections and add greatly to the comfort and convenience of the people. Schools and churches are conveniently located, and in some sections the children are hauled in busses to centralized consolidated schools. Practically all farms are connected by telephone and have rural free delivery of mail.

Mining of bituminous coal is the major industry. This is supplemented by the production of coke, the only byproduct made within the county. The total acreage of coal lands is given by the county

assessor as 334,563 acres, valued at $11,113,873. Since the discovery of oil and gas there has been a considerable spread in the field, but this is principally a gas field, and little oil is produced.

A high-tension power line extends across the county. This is stepped down by transformers at a number of substations, and the power is used by the larger mines, cities, and local industries.

Good drinking water is obtained from wells, springs, and streams, but many springs have failed since the opening of the coal mines and some streams are polluted by water discharged from the mines.

CLIMATE

The climate may be described as continental, as this section is too remote from the ocean to be appreciably affected by that body of water. It is characterized by the absence of great extremes of winter or summer temperatures and is fairly consistent to the latitude. The interseasonal differences in temperature are about 20° F., and the change from one season to another is usually gradual.

The data given in table 1 are compiled from the records of the United States Weather Bureau station at Indiana, which has an elevation of 1,350 feet above sea level, These data are probably fairly representative of the south-central and western parts of the county, but they hardly apply to the eastern and the extreme northern parts, where the elevations range from 300 to 700 feet higher. It would be expected that the country with the greater altitude would average colder weather, but the extremes of winter and summer are more likely to occur at the lower elevations. The winters are not continuously cold.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Indiana, Indiana County, Pa.*

[Elevation, 1,350 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1922)	Total amount for the wettest year (1888)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	30.5	72	−17	3.49	3.62	2.52	12.7
January	28.9	75	−21	4.07	2.03	6.75	15.5
February	28.3	70	−22	2.97	2.49	1.84	11.1
Winter	29.2	75	−22	10.53	8.14	11.11	39.3
March	38.5	84	−8	4.07	4.96	3.34	8.9
April	49.8	94	13	4.02	4.30	2.98	3.7
May	60.4	98	26	4.27	4.53	5.30	.1
Spring	49.6	98	−8	12.36	13.79	11.62	12.7
June	67.2	98	32	4.74	3.91	4.60	.0
July	71.3	103	40	4.45	4.47	7.04	.0
August	70.2	105	39	4.35	3.62	10.65	.0
Summer	69.6	105	32	13.54	12.00	22.29	.0
September	64.1	96	27	3.88	.62	2.82	.0
October	52.2	89	21	3.62	2.56	5.48	.1
November	41.0	79	7	2.70	2.34	2.75	2.6
Fall	52.4	96	7	10.20	5.52	11.05	2.7
Year	50.2	105	−22	46.63	39.45	56.07	54.7

The spring season is more often characterized by extremes than the fall months and is generally colder and more uncertain. The spring rains are often accompanied by east winds.

The summers are in general pleasant and mild. Occasionally hot spells occur, when the weather is rather oppressive, but they are usually of short duration, and the nights are generally cool. The greatest rainfall occurs during the summer months, generally as thundershowers accompanied by southerly or westerly winds.

The fall season usually approaches gradually and is one of the most agreeable parts of the year. The weather becomes very cool in November, but the climate is healthy and invigorating. The rainfall is less during the fall than during other seasons of the year.

June 10 is given as the date of the latest recorded killing frost and September 11 as the earliest. The average dates for the latest and earliest frosts are May 8 and October 2, respectively. This gives an average frost-free period of 147 days, which is ample for the production of a wide range of crops. Where, however, the elevations range from 300 to 700 feet higher, frost occurs somewhat later in both spring and fall, but the growing season is about the same length.

AGRICULTURAL HISTORY AND STATISTICS

The agricultural history of Indiana County began in 1769 when a settlement was made at the junction of Blacklick Creek and Conemaugh River. In 1771 or 1772, settlement spread to the vicinity of the present city of Indiana. In 1810, as reported by the county history, the total population was 6,214.

The first settlers were mainly hunters and trappers who subsisted largely on the wildlife then so abundant. Later, poultry, cattle, hogs, and work animals were brought in; lands were cleared; and such crops as corn, wheat, oats, and vegetables were produced. This early farming was a subsistence type of agriculture and consisted largely of the cultivation of small patches of land, in order to meet the needs of the homes. With increase in population and the development of towns and villages, crop areas were increased and the crops became the means of trade and barter.

In the early days, lack of equipment was a serious drawback to farming. The first plows were primitive affairs made of wood and lacking iron points. Subsequent cultivation was done with triangular harrows of wooden structure, including the spokes or spikes.

The early industries were maple-sugar making; the mining of salt, iron ore, limestone, and coal; and lumbering. The making of maple sugar was restricted to the colder months, beginning in February. A great number of orchards were operated, as sugar-maple trees were very plentiful in the central and western parts of the county. Salt was obtained from mines ranging from 300 to 600 feet in depth in the southern part, and the town of Saltsburg derived its name from this industry. Some iron ore was mined and smelted within the county, and two of the old furnaces are still standing. It is said that iron smelted at these furnaces was used to build cannon for the Army during the Revolutionary War. The mining of salt and iron ore were short-lived, but lumbering persisted and became an important industry, although most of the large operations were completed before the year 1880. The early mining of coal was

greatly restricted, on account of the lack of transportation facilities, but in 1853 the Pennsylvania Railroad built a branch line to Indiana, which was later followed by other lines and branches, marking the real beginning of the coal-mining industry within this county. The development of the coal-mining industry and the discovery and spread of the gas fields greatly modified the economic conditions and contributed largely to the prosperity of the people.

With the increase in the number and size of towns within the county, the demand for dairy products, poultry, eggs, dressed meat, truck, and fruit increased to such an extent that a gradual change was made from the ranging and feeding of livestock, with an extensive production of hay and grain, toward dairying and general farming or to the production of those crops that best meet or complement the requirements of the dairy interests. The previous utilization of poor crop land is attributed, in part, to the great demand for hay and grain before the mines were electrified, and probably more to the widespread leasing program developed with the spread of the gas fields and the opening up of so many new coal properties. Many of the leases paid the taxes of the farms, and some of them provided a surplus sufficient for the subsistence of the landowners. The production of farm crops, under these conditions, was under less hazard than would normally attend farming, and much land was utilized that was not especially suited to the production of crops. With the closing down of many mines, as a result of competition in other States or the limiting of production by short-time operation, many leases were terminated, and the prospects are that a considerable acreage in coal land will be abandoned. Much of this land, however, would be classed as unproductive for crops.

Until 1880, agriculture was of a general character, including the ranging and feeding of cattle and sheep. Before the mines were electrified, much feed and hay were sold locally for the mules and horses used in them, and the concentration of people engaged in mining afforded a market for such farm produce as vegetables, meat, butter, poultry, and eggs.

The population in 1880 numbered 40,527, all classed as rural. The population reached its maximum in 1920 when 66,609 people were classed as rural and 14,301 as urban. The 1930 census reports a total of 75,395 people, which is a decrease of 5,515 since 1920.

The number of farms in 1880 was 4,438 and in 1930 was 3,058. The farms range in size from less than 3 to more than 1,000 acres, but the greater number are in the group between 50 and 175 acres. The tendency is toward larger farms, as they are considered more adequate for economic production of crops. The average acre value of farm land, including buildings, was $52.13 in 1930. The range in value was from $7 to $150 an acre. The census reports show a slight decrease in the percentage of improved land in farms, from 68.3 percent in 1880 to 65.1 percent in 1930.

Corn, oats, wheat, rye, buckwheat, and hay are the principal crops grown. Hay has always been an important crop, and it occupies the largest acreage. In 1879, 37,266 acres were devoted to this crop. The acreage increased to 55,454 acres in 1889 but decreased to 45,825

acres in 1929. Oats occupy the next largest acreage. They were grown on 31,260 acres in 1879, and in 1929 only 20,772 acres were devoted to this crop. The acreage in corn in 1879 was 29,146 acres but decreased to 16,380 acres in 1929. With the exception of the years 1879 and 1899, when the acreage of wheat was somewhat greater, wheat has always occupied a subordinate position. In 1929 the acreage reported was 9,638 acres. Buckwheat is the next most important small-grain crop, occupying 9,035 acres in 1879, and reaching its maximum acreage in 1909 when it occupied 20,303 acres. This decreased in 1929 to 9,270 acres. Rye has a somewhat similar history. It occupied an acreage of 9,262 acres in 1879 and reached its maximum in 1899 with 10,425 acres and decreased to 6,549 acres in 1929. Potatoes reached their maximum acreage in 1909 with 4,116 acres, and in 1929 only 2,622 acres were devoted to this crop.

The average acre yield of wheat in 1925 was 14.1 bushels, and in 1926 was 14.8 bushels; of oats 37.8 bushels in 1925 and 27.1 bushels in 1926; of rye 14.5 bushels in 1925 and the same in 1926; of buckwheat 26.5 bushels in 1925 and 17.3 bushels in 1926; of potatoes 128 bushels in 1925 and 121 bushels in 1926; and of corn 44.8 bushels in 1925 and 35.5 bushels in 1926.[1]

The character of farming in Indiana County shows a dominant shift to dairying. This is reflected in the statistics of the United States census report of 1930 which lists the total number of cattle on farms as 22,055, of which 723 were beef or dual-purpose cattle. It further lists the number of cows and heifers milked as 11,239. The total number of gallons of milk produced in 1929 was 5,897,114, of which 2,819,508 gallons were sold as whole milk.

Since dairy cattle have largely replaced beef cattle, the predominant breeds are Jersey, Holstein-Friesian, and Guernsey. The cattle were first tested for tuberculosis on a county-wide basis in 1925, and this county qualified as an accredited area in 1926. It again qualified in 1929, at which time 21,000 cattle were tested. Some 200 herds are also tested for Bang's disease. The number of purebred bulls has increased, and these during the last 10 years have had an important influence in improving the dairy animals. Two cow-testing associations in the county have an average annual production of well above 300 pounds of butterfat a cow.

There are a few beef-type herds of breeding cattle, and a few farmers make a practice of fattening beef cattle. A local packing house furnishes a market for beef cattle, veal calves, sheep, and hogs. A few buyers purchase cattle, sheep, and hogs within the county and transport them by truck to Pittsburgh, where they are resold.

Approximately 8,000 breeding sheep are kept on the farms, and the lamb crop numbers about 8,000. Many of the lambs are trucked to Pittsburgh and other nearby markets, as the local demand for lamb and mutton is small. The wool is pooled by a county sheep and wool association and sold to the highest bidder. In 1931 the pool amounted to 44,000 pounds of wool which was consigned by 285 sheep raisers. The predominating breed of sheep is Hampshire,

[1] JORDAN, C. G., WIBLE, L. H., KOENIG, P. L., and GASTEIGER, E. L. PENNSYLVANIA'S FARMS, CROPS, AND LIVESTOCK, 1926 . . Pa. Dept. Agr. Gen. Bull. 445 (vol. 10, no. 9), 249 pp., illus. 1927.

and some farmers have flocks headed by Shropshire, Oxford, and Southdown rams. There are very few purebred sheep, and none of the flocks consists of fine-wool breeds. Most of the sheep are owned by farmers who keep from 15 to 40 head.

Hogs are of minor importance in a commercial way. The 1930 census reports the number as 6,185 which was a considerable decrease since 1920, when 19,497 were reported. Most farmers keep from one to three brood sows to furnish the home with pork and to provide pigs and fat hogs for local markets. The pastures are more generally used for hogs than formerly, and very little corn is now hogged down. The principal breeds of hogs are Berkshire, Poland China, Duroc-Jersey, and Chester White. Internal parasites are a serious difficulty in raising hogs, but hog cholera is seldom a menace.

Poultry flocks have increased in size, and many large flocks are now common throughout the county, flocks numbering from 500 to 1,000 being found in every township. White Leghorn is the predominating breed, although many poultrymen and farmers have flocks of Plymouth Rocks, Rhode Island Reds, and Wyandottes. Eggs are marketed largely to hucksters, who haul them to markets near Pittsburgh. The many towns are supplied by nearby farmers, and some of the eggs produced in this county are shipped to New York City. Very few eggs are graded. The local demand for live poultry is good. Hucksters buy the poultry and take it to Pittsburgh, Johnstown, and other cities for resale. Turkey raising is increasing, and a number of large flocks are raised every year. One farmer raised 1,000 turkeys in 1930 and 800 in 1931. The local demand is not great enough to dispose of all the turkeys, and they are sold to dealers in the larger cities.

Horses are commonly used as draft animals, but many farmers prefer mules. Several stallions are in use in the county, as the farmers are becoming more interested in the development of special types of draft horses, most of which are Percherons and Belgians. A number of dealers are shipping in carloads of western horses and colts to supplement the local supply.

The labor utilized for farm work is largely native and on most farms consists of the owner and his family. Where extra labor is employed by the month, wages range from $25 to $40, and about $2 is paid for labor employed by the day. Farmers usually exchange help among themselves during threshing time.

The census report of 1930 gives the number of farms operated by owners as 2,712; by tenants, 304; and by managers, 42. The system of tenancy is generally worked out on the share basis and provides for equal shares of the crops and the income from livestock, the owner and tenant each bearing one-half of the expenses. Some variations of this plan are in use by a few operators.

The buildings on most farms consist of a dwelling; barns for housing livestock, storing grain, hay, straw, and other farm products; buildings for sheltering machinery and implements; also hogpens, chicken houses, and corncribs. The farm dwellings range widely in character. Some are very imposing, pretentious structures of stone,

wood, or brick, and others are not much more than a roof and four unpainted walls. In general, however, the buildings are homelike and are accompanied by a well-equipped set of outbuildings. Many of the older and original homes were built near springs and watercourses, with little regard for the advantages or disadvantages of location.

Most Indiana County farms require considerable equipment. Although many farmers use tractors, very few horses are being displaced in this way. Motortrucks are used by most farmers for marketing their produce and for hauling lime, fertilizer, dairy feeds, and other heavy materials. Threshing is done largely by custom machines, and many groups of three or four farmers own a machine. Binders are used on nearly every farm, and a few drop reapers are still in use in harvesting buckwheat. Grain drills are used almost exclusively for seeding. The 2-row corn planter and double corn worker are in general use. A few farmers are using crawler-type tractors with deep-tillage tools for potatoes. The combination power sprayer is used by many farmers for orchards and potatoes. The corn husker is used by many, although a large percentage of the corn crop is still cut by hand and husked in the field by hand. Corn binders are in general use for cutting silage corn and some of the corn to be husked. The side-delivery hayrake is replacing the dump rake. Hay loaders are used largely on the less hilly farms. The 4- and 6-row weeder is being used more extensively by potato growers and by some farmers in cultivating corn.

As has been stated, the principal crops are corn, oats, wheat, and hay (timothy and clover mixed, timothy, or clover alone). Other crops are rye, barley, buckwheat, potatoes, alfalfa, and beans, in addition to such vegetables as tomatoes, sweet corn, celery, cabbage, carrots, lettuce, beets, onions, cauliflower, spinach, horseradish, eggplant, and broccoli. Strawberries, currants, and cane fruits, as blackberries and raspberries, are grown by many farmers. The main tree fruits are apples, plums, cherries, pears, and peaches, and grapes are grown on most farms.

SOILS AND CROPS

Indiana County is included in the physiographic division known as the Allegheny Plateau. It occupies a topographic position intermediate between the high and low extremes of altitude, and plateaulike characteristics are not so evident, as they have been greatly modified and altered in the development of the present drainage system. The dissection of the land surface has been more complete in the western than in the eastern part of the county, although even here the principal valleys are deeply entrenched. The soils are variable and have a rather wide range in character. Some have been formed from materials weathered in place through the action of soil-forming agencies for long periods of time; some from materials removed from the uplands by erosion and deposited in the lower benches; and some from similar materials deposited on the flood plains of the rivers and streams. The upland soils in general are

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thin, as most of the land surface is rolling and consequently subject to erosion, especially when not well covered by vegetation. The deepest soils occur on the lower benches and the older terraces. On the first-bottom or overflow land the soils are more shallow along the smaller streams and deeper along the larger streams and rivers. The deep soils, as a rule, have smooth surface relief, and in places they are imperfectly drained. In general, they are considered among the most valuable soils of this part of the county. Most of the county is smoothly rolling or hilly country, including a considerable proportion of steeply hilly land unsuited to crop production. Of the total acreage of the county in 1930, 312,979 acres are in farms. The farm land includes 67,229 acres in woodland, which leaves the total amount of cleared land 245,750 acres. The same authority lists the acreage in cropland as 159,947 acres.

The subsistence crops, such as hay, corn, and oats, have been grown in Indiana County for a long time. The soils and climate are suited to their growth, and they fit in with cropping systems adapted to this section, so that changes in the economic conditions seem to result largely in curtailment or extension of their acreage. More land is utilized for the production of hay than of any other crop, according to the 1930 United States census report, and the acreage devoted to hay in 1929 was 28.7 percent of the total cropland. Oats rank next in acreage, occupying 13.1 percent of the cropland; corn occupies 12.3 percent; wheat, 7.8 percent; buckwheat, 6 percent; rye, 4.1 percent; and potatoes, 1.6 percent.

Gardens and orchards comprise a part of most farms. On some farms the acreage is large, and the farmers sell the surplus products to local and more distant markets. Some of the potatoes, buckwheat, fruit, and vegetables are consumed on the farms, but most of these products are sold. Buckwheat is the most important cash crop, but its acreage is decreasing. On some farms buckwheat is included in a definite rotation or is used as a catch crop. It is especially well adapted to the light upland soils. Potatoes are next in importance, and their acreage seems to be increasing. They are grown on all farms and are considered an essential garden product. Their production on a commercial scale has largely been stimulated by unusual local market conditions.

The soils as mapped have a very spotted or mixed appearance, but they conform to general lines of distribution. Most of the areas are small. Some of the largest soil areas in the uplands are in the eastern part of the county, and others occupy the river and stream terraces in the larger valleys.

A grouping of the soils can be established on those characteristics which are of importance in plant growth or which indicate other properties of importance, such as color, texture, structure, content of organic matter, and drainage. The first general grouping is based on drainage and includes (1) well-drained soils, (2) imperfectly drained soils, and (3) poorly drained soils.

In the following pages, the soils of Indiana County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 2.

TABLE 2.—*Acreage and proportionate extent of soils mapped in Indiana County, Pa.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Westmoreland silt loam	8,384	1.6	Dekalb gravelly sandy loam	2,304	0.4
Westmoreland shaly silt loam	2,880	.5	Dekalb shaly silt loam	2,112	.4
Westmoreland gravelly silt loam	4,160	.8	Dekalb shaly silt loam, steep phase	5,248	1.0
Westmoreland gravelly silt loam, steep phase	1,856	.3	Dekalb stony loam	1,664	.3
Brooke silty clay loam	384	.1	Dekalb stony silt loam	2,560	.5
Belmont silt loam	2,624	.5	Dekalb stony silt loam, steep phase	3,520	.7
Upshur silt loam	4,288	.8	Leetonia gravelly sandy loam	12,160	2.3
Upshur silt loam, steep phase	896	.2	Leetonia gravelly sandy loam, steep phase	704	.1
Rayne silt loam	12,224	2.3	Leetonia stony sandy loam	7,488	1.4
Rayne gravelly silt loam	26,112	4.9	Leetonia stony sandy loam, steep phase	2,624	.5
Rayne stony silt loam	1,344	.3	Rough stony land	38,208	7.2
Rayne shaly silt loam	37,952	7.1	Cookport silt loam	21,824	4.1
Gilpin gravelly silt loam	22,912	4.3	Cookport silt loam, poorly drained phase	1,536	.3
Gilpin gravelly silt loam, steep phase	37,440	7.1	Cavode silt loam	4,608	.9
Gilpin stony loam	960	.2	Ernest silt loam	48,192	9.1
Gilpin stony loam, steep phase	2,816	.5	Ernest silt loam, calcareous phase	12,416	2.3
Gilpin gravelly sandy loam	1,152	.2	Monongahela silt loam	13,376	2.5
Gilpin shaly silt loam	8,320	1.6	Pope silt loam	11,712	2.2
Gilpin shaly silt loam, steep phase	18,624	3.5	Pope loam	5,248	1.0
Clymer gravelly silt loam	40,384	7.6	Lickdale silt loam	2,432	.5
Clymer silt loam	10,432	2.0	Robertsville silt loam	1,216	.2
Clymer shaly silt loam	29,952	5.6	Atkins silt loam	10,688	2.0
Clymer stony silt loam	7,488	1.4	Alluvial soils, undifferentiated	9,856	1.9
Dekalb gravelly silt loam	18,880	3.6			
Dekalb gravelly silt loam, steep phase	6,400	1.2	Total	530,560	

WELL-DRAINED SOILS

The well-drained soils occupy more than three-fourths of the total area of the county, and the relief ranges from favorable to unfavorable, as regards cultivation and the use of machinery. On the tops of the ridges and on gentle slopes, improved labor-saving machinery can be utilized and crops can be more economically grown than on the steeper slopes where, in many places, grain must be harvested with a cradle. On the steep slopes where drainage is excessive, the soils are very shallow and in places the parent rock material is exposed. In a country where so much of the land is steep, it is surprising that erosion has not been more pronounced, but the chippy and flaggy character of the stones in the surface soils seems to allow more ready absorption of rain water, and the subsoils, with some exceptions, although generally shallow, allow free movement of soil moisture and still retain sufficient for crops in a season of normal rainfall.

The color of the surface soil in cultivated fields ranges from gray to chocolate brown. In the forested areas the color ranges from dark brown to almost black, with wide variations in the character of the organic matter, but when these soils have been subjected to tillage operations for any length of time the dark color disappears.

The well-drained soils may be separated into three subgroups, with respect to color, and particularly the color of the surface soil in cultivated fields. The first subgroup, including the chocolate-colored soils with dark-brown or chocolate-brown surface soils and brown, light-brown, or reddish-brown subsoils, is designated the Westmoreland group; the second, including the grayish-brown soils with buff or light-brown subsoils, is designated the Rayne group; and the third, comprising the gray soils with gray and dark-gray surface soils and yellow or buff subsoils, is designated the Dekalb group.

WESTMORELAND GROUP

The Westmoreland group comprises those soils that have reddish-brown or dark-brown surface soils and brown, light-brown, or reddish-brown subsoils, and it includes all the soils of the Westmoreland, Brooke, Upshur, and Belmont series mapped. The soils are developed mainly in the southwestern part of the county and occupy an aggregate area of 39.8 square miles, or 4.8 percent of the total area. The members of this group do not occur in large broad areas but in small spots or streaks interrupted by members of this and other groups. Most areas of these soils occupy low rolling country with a generally more favorable surface relief than the soils of the Dekalb and Rayne groups.

The soils of the Westmoreland group have good surface and subsurface drainage in some of the lighter members, but where the subsoils are heavy, free movement of internal moisture is more or less obstructed. Sheet erosion is sometimes active where the land is poorly managed, and, where the slopes are steep, trenching and gullying are not uncommon. The Westmoreland group comprises most of the heavy soils in the county. The subsoils of some of the soils are close in structure, plastic and sticky when wet, and appreciably heavier than the subsoils of members of the other groups. This group includes soils that have been influenced directly or indirectly in their development by the presence of limestone, and they range from alkaline to slightly acid in reaction. Therefore, applications of lime are not so frequent or so heavy as is necessary on soils of the Rayne and Dekalb groups.

These soils are considered productive and have a high content and considerable range in the elements of plant nutrients, but they are handicapped or suffer restriction in places where the soils are difficult to work and to put in good physical condition. Crops get a late start on most of these soils, as they do not warm up so early as the soils of the Rayne or Dekalb groups, owing to the heavy character of the subsoils.

The agriculture on these soils consists mainly of general farming and dairying, and some cattle and sheep are ranged and fed. The crops grown are corn, wheat, oats, and hay, but very little buckwheat and rye are grown, as these crops are restricted in general to the light-textured soils. The soils of this group are excellent grazing and pasture land, and more Kentucky bluegrass grows on them than in any other section of the county.

Westmoreland silt loam.—The surface soil of Westmoreland silt loam consists of brown or grayish-brown silt loam which becomes heavier to a depth of about 10 inches where it passes into brown or brownish-yellow silty clay loam. This material may extend to a depth of 18 inches where it passes into mottled gray, brownish-yellow, and rust-brown silty clay or heavy silty clay loam. The general color of the subsoil is brownish yellow. The total depth of the soil material is variable, ranging from about 24 to 70 inches. This soil may rest on shales, sandy shales, or sandstone, with some interbedded limestone. In some places the shales and sandy shales are calcareous. Over the surface is a slight scattering of shale chips or flags, which are not so common or conspicuous, however, as on

Westmoreland shaly silt loam or Westmoreland gravelly silt loam, and they do not occur in sufficient quantities to interfere with cultivation.

This soil occurs in the vicinity of Iselin, Elders Ridge, West Lebanon, Conemaugh Church, Smith, Campbells Mill, and in other places throughout the southwestern part of the county.

Most of the Westmoreland silt loam areas have favorable surface relief and occur on the tops of ridges and more gentle slopes. This soil includes some local areas where the surface relief is somewhat steep. Like most members of this group, the soil erodes and washes easily when poorly managed.

Nearly all the land is cleared, and it is estimated that about 90 percent is open country. The rest of it supports a woodland growth of various oaks, butternut, poplar, chestnut, sassafras, and locust. Many of the trees are large. Much of the undergrowth consists of small sassafras bushes, blackberry, myrrh, and a few dogwoods. Kentucky bluegrass is one of the abundant grasses on this soil, and excellent pastures have been developed.

Where cultivated this soil is used principally for the production of corn, wheat, oats, potatoes, and hay, and for pasture. Corn occupies about 20 percent, wheat 13 percent, and oats 16 percent of the cropland, and the rest is used for hay and pasture. Rye, buckwheat, and barley are rarely grown, as these crops are generally restricted to lighter textured soils. The reported acre yields of corn range from 30 to 50 bushels, oats from 40 to 50 bushels, wheat from 15 to 30 bushels, potatoes from 150 to 200 bushels, and hay from 1 to 2 tons. These crops are said to do best in wet years. Apples do well on this soil, but peaches are said to be unadapted to it. The principal varieties of apples grown are the Baldwin, McIntosh, Northern Spy, and Wayne.

Fertility of this soil can be maintained and developed by the use of lime, manure, and superphosphate. This is considered one of the best soils in the county for the production of grains and grasses. Dairying and livestock production dominate the agriculture of Westmoreland silt loam.

Westmoreland shaly silt loam.—The 6- to 8-inch surface soil of Westmoreland shaly silt loam is brown or grayish-brown silt loam which passes rather abruptly into brownish-yellow silty clay. This material in few places extends below a depth of 20 inches. It rests on shale intermixed with brown silt loam, under which is bedrock of shale, calcareous shale or interbedded limestone at various depths. Over the surface and throughout the soil are numerous small, thin angular chips of shale or shaly sandstone.

This soil occurs in the vicinities of Iselin, Nowrytown, Elders Ridge, and Aultman, and in other places throughout the southwestern part of the county. In general it occupies rolling country, especially ridges, knolls, and more gentle slopes. The surface relief causes it to be less favorable for agricultural purposes than Westmoreland silt loam. The soil has less depth than the silt loam and is somewhat better drained, and crops can be worked sooner after rains.

About 80 percent of the land is cleared, and the rest is in wood lots or brush. The tree growth consists of red oak, white oak, black

oak, hickory, dogwood, cherry, and locust, and the undergrowth is sassafras, dogwood, blackberry, and myrrh.

The soil is used for the production of corn, wheat, oats, potatoes, hay, pasture, and fruit. Corn occupies about 15 percent, oats 20 percent, wheat 12 percent, and potatoes 2 percent of the cultivated land, and the rest is in hay and pasture. Acre yields reported for corn range from 30 to 45 bushels, oats 30 to 40 bushels, wheat 15 to 30 bushels, potatoes 150 to 200 bushels, and hay 1 to 1½ tons.

Westmoreland shaly silt loam is not a difficult soil to work, owing to the presence of the shale chips. It is a lighter soil than the silt loam of the series, warms up earlier in the spring, and crops on it mature sooner. It is not so well adapted to grass and grain, and the pastures are not so persistent as those on the heavier Westmoreland soils, but it produces good yields of potatoes, truck crops, and fruit.

Included with this soil as mapped, because of their very restricted distribution, are a few small spots of Westmoreland shaly silt loam, sandy phase. These areas occur along and near the western county line southwest of Elders Ridge. They differ from the typical soil in that the surface soil and subsoil are more sandy, but they have about the same agricultural value.

Westmoreland gravelly silt loam.—The surface soil of Westmoreland gravelly silt loam consists of brown or grayish-brown silt loam to a depth of about 10 inches, where the material becomes somewhat heavier and grades into brownish-yellow silty clay which extends to a depth of about 24 inches and rests on shale or shaly sandstone with interbedded limestone or calcareous shale. Over the surface and throughout the soil is a conspicuous quantity of angular flaggy sandstone or shale fragments ranging from 2 to 5 inches in diameter and from one-half to 1 inch in thickness. Included with this soil as mapped are a few small areas of Westmoreland sandy loam, which are not shown separately on account of their small extent. These spots occur near the county line in the vicinity of Foster.

Westmoreland gravelly silt loam is restricted largely to the southwestern part of the county, although a few isolated patches occur in other parts. It is well developed in detached areas in the vicinities of Elders Ridge, Iselin, Aultman, and West Lebanon, and in other places throughout this section.

This soil occupies rolling country, more particularly ridge crests, knolls, and gentle slopes, and the surface relief is, in general, favorable to the production of crops. Most of the land is well drained, but it does not warm up quite so early in the spring as Westmoreland shaly silt loam. Probably 80 percent of it is cleared, and the rest is in wood lots and brush. The tree growth includes various oaks, hickory, dogwood, wild cherry, locust, and butternut, and the undergrowth is sassafras, blackberry, small dogwood, and myrrh. In the more open places Kentucky bluegrass is abundant.

Where cultivated this soil is used for the production of corn, wheat, oats, potatoes, hay, and pasture. Rye, barley, and buckwheat are rarely grown. Corn occupies about 20 percent, wheat 15 percent, oats 20 percent, and potatoes 3 percent of the cultivated land, and the rest is in hay and pasture. The acre yields reported for

corn range from 50 to 80 bushels, wheat 15 to 35 bushels, oats 30 to 60 bushels, potatoes 100 to 200 bushels, and mixed hay from 1 to 1½ tons.

This soil is somewhat more difficult to work than the other soils of the group, on account of the number of flaggy stones on the surface, which are particularly destructive of tools and equipment. Much labor has been expended in places to partly remove the stones, and stone fences and stone heaps are conspicuous.

Westmoreland gravelly silt loam is considered a strong soil for grass and grain, and pastures on this land are said to be very persistent.

Westmoreland gravelly silt loam, steep phase.—The steep phase of Westmoreland gravelly silt loam has the same general characteristics as the typical soil, with the exception that it is in general more shallow. As it occupies steep slopes, less water penetrates the soil for the growth of plants and subsequent soil development, and it is exposed to more serious erosion. In many places the underlying rock is exposed.

Soil of this phase occurs in the vicinities of Clarksburg and Elders Ridge, and in other places throughout the southwestern part of the county. About 50 percent of the land is farmed, and the rest supports a growth of trees and brush. Where farmed some of it is used occasionally for grain, but most of it is included in pasture.

Crops cannot be so economically produced on this steep land as on the typical soil where all kinds of labor-saving machinery can be used. Most of the grain grown is harvested by hand with a cradle. Under the present tendency to develop permanent pastures, it would seem that the grass acreage could profitably be extended on soil of this phase.

Brooke silty clay loam.—The 5- to 8-inch surface soil of Brooke silty clay loam consists of yellowish-brown or brown silty clay loam having a granular structure. This passes gradually into reddish-brown, yellowish-brown, or olive-colored clay loam which may extend to a depth of 15 or 18 inches, where it usually changes into heavy clay loam or clay of an olive or brownish-yellow color and of a more plastic and sticky character. This material rests on limestone at a depth between 24 and 30 inches. Some limestone fragments, angular in shape but generally smooth, are scattered over the surface. Locally, variations occur in the color and depth of the soil material. The color in many places is influenced by the proximity of other soils and local wash. The depth is modified by the degree of slope. As limestone is replaced with calcareous shales and sandstones, the soil approaches those of the Westmoreland series.

Brooke silty clay loam is one of the less extensive soils. It occurs in the vicinities of Elders Ridge and West Lebanon and at other places throughout the southwestern part of the county. Most of it occupies the tops of knobs, hills, and ridges. Drainage is well established but is apt to be excessive, and local washes are abundant in positions where other soils would hardly be affected.

Practically all this land is utilized for agriculture. A few scattered trees grow along fence lines or around farm homes. Black locust is predominant, and there are various kinds of oaks, hickory, poplar, and maple.

Where cultivated, the land is used for the production of corn, wheat, oats, potatoes, hay, and pasture. Corn occupies about 8 percent, wheat 6 percent, oats 8 percent, and potatoes 1 percent of the cropped land, and the rest is used for hay and pasture, with pasture predominating. The acre yields reported for corn range from 40 to 60 bushels, wheat 15 to 25 bushels, oats 40 to 50 bushels, potatoes 40 to 100 bushels, and hay 1 to 2 tons.

Tillage is difficult on Brooke silty clay loam. If too wet the soil sticks to the plow and forms clods which do not break so easily as when the land is plowed dry. For this reason, much of this land is kept in pasture. It is considered a fertile soil for the production of grass, grain, and alfalfa. The pastures are lasting and are conspicuous for the amount of Kentucky bluegrass in them.

Belmont silt loam.—The surface soil of Belmont silt loam consists of a 6- or 8-inch layer of reddish-brown or grayish-brown heavy silt loam or light silty clay loam. This passes rather abruptly into yellowish-brown silty clay which in few places extends below a depth of 15 inches, where it passes rather quickly into variegated or brightly mottled red, gray, and brown blocky clay. To a depth of about 40 inches, the gray color becomes increasingly dominant, the red and brown colors become less conspicuous, and the clay becomes more plastic and sticky.

Belmont silt loam in Indiana County appears to be in an intermediate, or transitional, position between the Upshur soils on one hand and the Westmoreland on the other. It is well developed near Indiana, Tannery, Watts Hill, and Smathers, and in other places throughout the southwestern part of the county, to which section it is largely restricted.

This soil occupies gently sloping or slightly rolling country. It is well drained in most places, but it includes some local spots of Ernest soils which are imperfectly drained.

About 95 percent of this soil is cropland, and the rest is in wood lots which include mainly several varieties of large oaks, hickory, maple, poplar, and locust. Where cultivated the land is used for the production of corn, potatoes, wheat, oats, rye, hay, and pasture. Corn is grown on about 22 percent, oats on 25 percent, wheat on 15 percent, rye on 5 percent, and potatoes on 3 percent of the land, and the rest is in hay and pasture. The reported acre yields of corn range from 40 to 60 bushels, oats 40 to 60 bushels, wheat 20 to 35 bushels, rye 15 to 30 bushels, potatoes 100 to 200 bushels, and hay 1 to 2 tons. The pastures are easily maintained and are said to last a long time.

Belmont silt loam is considered one of the most productive soils for the growth of general farm crops. It is easy to work and has favorable surface relief. Crops can be economically produced on this land, as all kinds of labor-saving machinery can be utilized.

Included with this soil as mapped are some spots of Meigs silt loam, which are too small to be shown separately. Meigs silt loam in general is a mixture of Upshur and Cavode soils or Upshur and Westmoreland soils, so intimately associated that the several types could not be separated. It represents a soil condition rather than a soil type. It usually occurs as small spots or streaks and is exposed on hillsides or valley slopes in the central and western parts of the county. It is well developed northeast of Indiana and east of Sharps-

burg. The value of this land depends on the dominant included soil. If the proportion of Cavode material is greatest the soil is not very productive, but if the Upshur or Westmoreland soils dominate it partakes more of the value of these soils.

Upshur silt loam.—The surface soil of Upshur silt loam consists of dark-brown or reddish-brown mellow silt loam from 8 to 12 inches thick. The material becomes slightly heavier in the lower part of the surface layer and grades into brown or reddish-brown silty clay which becomes more red and more plastic with depth. This layer in most places is uniform in color and texture, but it is of variable thickness and may terminate at any depth below 24 inches. Underneath this layer the material is very heavy and of various colors. In places it is reddish brown splotched with gray, yellow, or purple, and in others it is dingy yellow mottled with gray, purple, and brown. The soil material above the rock in most places ranges from 8 to 10 feet in thickness. In many places shallow beds of limestone, particularly weathered limestone or concretionary limestone, or red and gray shales occur throughout the lower part of the subsoil, with weathered material above or below, and in some places the soil material rests directly on bedrock of red or gray shale with interbedded limestone.

Included with Upshur silt loam as mapped are bodies of soil having a conspicuous quantity of large or cobbly fragments scattered over the surface. Areas of such soil, which are of small extent, occur 1 mile southeast of Willet, 1½ miles southwest of Iselin, 3 miles northeast of Shelocta, and at other places throughout the county. This soil occupies similar positions and has about the same value as Upshur silt loam, except that it is somewhat more difficult to work on account of the stone fragments on the surface.

Also included with Upshur silt loam are a few local spots of Upshur gravelly silt loam, which were not separated in mapping because of their small extent. The largest body lies 2½ miles northwest of Indiana. The difference between this soil and typical Upshur silt loam is a conspicuous quantity of very small irregular fragments of sandstone and shale scattered over the surface. The land is not difficult to work and has about the same agricultural use as the typical soil.

Some areas of a soil included with Upshur silt loam consist of red or reddish-brown silty clay or clay loam, from 5 to 10 inches thick, passing rather abruptly into dull-red silty clay which, between depths of 15 and 24 inches, passes into heavy plastic clay. This layer in most places is gray or dull yellow, splotched with red, purple, and brown, and it includes seams of partly weathered limestone or concretionary limestone, calcareous red or gray shales, or shaly sandstone. This mottled layer varies in thickness, and it rests directly on bedrock of shales and sandstone with interbedded limestone. In places the total depth of the soil exceeds 5 feet.

The aggregate area of this clay loam soil is small. The principal bodies are in the southwestern part of the county, near Smathers and northeast of Livermore, and at other places throughout the county. This soil occupies the tops of ridges, knobs, saddles, and more gentle slopes, in positions generally less favorable for agricultural use than typical Upshur silt loam, and it represents a

shallow phase of the silt loam or silt loam that has been subject to more or less wash and erosion. Most of this included land has been cleared, but in a few places it supports a mixed growth of oaks, poplar, elm, hickory, maple, and locust.

As tillage is difficult on this soil, this may be the reason that so little of it is utilized for crops. Some farmers report that good results are obtained when the land is broken in the fall or early in the spring, as the clods break down easily after freezing. The soil is said to be productive if it receives good preparation. It requires less lime than the Rayne soils, and the addition of lime and manure is said to improve its physical characteristics.

Most of the Upshur silt loam occurs in the saddles of the divides and on the valley slopes. In a few places the surface relief is rather steep, but in most places it is favorable for agricultural use. Practically all the land is cleared. A few trees grow near the farm homes or along the fence lines. The trees are mainly various kinds of oaks, together with some maple, cherry, elm, dogwood, poplar, and locust. Most of them are large, and the ground in most places is free of underbrush.

Where cultivated Upshur silt loam is used for the production of corn, wheat, oats, rye, potatoes, mixed hay, pasture, and fruit. Corn occupies about 20 percent, wheat 12 percent, rye 9 percent, oats 22 percent, potatoes 2 percent, and fruit 3 percent of the cropland, and the rest is in mixed hay and pasture. Acre yields of corn range from 45 to 60 bushels, wheat 18 to 25 bushels, oats 40 to 50 bushels, rye 15 to 20 bushels, potatoes 150 to 200 bushels, and mixed hay 1 to 1½ tons. Apples, peaches, plums, and cherries do well on this soil.

Although this soil occupies a position generally favorable for the production of crops, it is inclined to wash unless carefully managed. The surface soil is rather variable in depth, and in places washing has exposed the underlying clay. Where such spots are numerous the land is rather difficult to work. Upshur silt loam is considered an excellent soil for dairy farming and can be developed to a high state of productiveness.

Upshur silt loam, steep phase.—Upshur silt loam, steep phase, has the same general characteristics as typical Upshur silt loam, but it is generally more shallow and occupies steep positions. Bedrock is exposed in many places, as this steep land is subject to severe wash and erosion, especially where the land is unprotected by close-growing plants. In some spots the silt loam surface soil has been more or less completely removed, and the exposed soil has more the characteristics of clay or clay loam.

This steep soil is one of the less extensive soils of the county. It is largely restricted to the western and southwestern parts, particularly 3½ miles west of Graceton, south of Indiana, and 2 miles south of Crete, and it occurs to some extent in other places throughout the county. It occupies slopes which are in general too steep for the economic production of crops, and, although most of the land has been cleared, much of it is utilized for pastures. Occasionally crops of hay, rye, or buckwheat are grown, but the harvesting of crops involves the use of considerable hand labor. The pastures are persistent but not so much so as on the Westmoreland or Brooke soils, and

Kentucky bluegrass is not so abundant on this soil. Some effort should be made to plan the use of this soil so as to protect the land from excessive wash. The rougher and steeper areas should be planted to evergreens or other forest trees.

Included with areas of this soil as shown on the map, on account of their small extent, are some local spots of Upshur gravelly silt loam, steep phase. One such body lies 2½ miles northwest of Indiana.

RAYNE GROUP

The group of soils with grayish-brown surface soils and yellow or light-brown subsoils is termed the Rayne group and includes all the members of the Rayne and Gilpin series. These soils are well developed in the central and northwestern parts of the county, also in the upper part of Brush Valley and in the vicinity of Penn Run. These soils do not occur in large broad areas but are rather mixed or spotted and interrupted in distribution by members of this and other groups. The total area occupied by the soils of this group is 265.4 square miles, or 32 percent of the total area of the county. These soils occupy rolling or hilly country, and with the exception of some areas of the Gilpin soils, which are less rugged, the surface relief is somewhat bolder than that of soils of the Westmoreland group.

Drainage is well established for the removal of surface and subsurface waters; in fact, surface drainage is excessive in all except the Rayne soils which show the least damage from erosion and have the deepest profiles. The other soils are shallow as a result of excessive surface drainage.

The surface soils have a silty texture, are easy to work, and do not bake or run together, as appears to be the tendency of the soils of the Westmoreland group. The soils of this group have a good average supply of organic matter in the surface soil. In undisturbed forested areas, the surface is usually littered with leaves and forest debris; under this is a compact leaf layer, the lower part of which is partly or completely decomposed leaf mold. This lies just above the mineral matter of the soil and in some places is intimately mixed with the inorganic material. The trees on the soils of the Rayne group, where they have had time to develop, are large, and they are almost exclusively hardwoods, such as various oaks, maple, hickory, elm, and dogwood. All the soils of this group range from slightly acid to acid in reaction, a condition generally recognized by farmers, and lime is applied regularly for correction.

These soils warm up early in the spring, and crops usually get a good start. The soils have a wider crop adaptation than the soils of the other groups, and they have the greatest range of products. They are successfully used for general farm crops, fruit, and truck, which form an ideal complement to the established dairy interests. Although excellent pastures have been developed on some of these soils, they are not naturally so good nor so persistent as on the soils of the Westmoreland group, which seem to be more restricted in adaptation and use, yet individual effort or efficiency in places has widened their adaptation to such a degree that results are almost comparable to those on soils of the Rayne group. One obvious difference is the greater difficulty in obtaining good tilth on soils of the

Westmoreland group, and success in this may widen the productivity of these soils.

As compared with the soils of the Dekalb group, the soils of the Rayne group are normally rich in plant nutrients and those of the Dekalb group are deficient. Although acid, the soils of the Rayne group are less acid than the Dekalb soils, and excellent crops can be grown where the timber and brush are removed, whereas the soils of the Dekalb group do not produce good crops when the vegetation is removed and must be built up by careful and intelligent treatment before they will produce good yields.

The soils of the Rayne group dominate the agriculture of the county, on account of their wider degree of usefulness, their natural productiveness, and their location with respect to good roads and transportation facilities.

Rayne silt loam.—The surface soil of Rayne silt loam consists of grayish-brown or dark-brown mellow silt loam, in most places extending to a depth of about 10 inches. Below this depth the material is heavier, lighter colored, and more compact silty clay loam or silty clay, which, in most places, extends below a depth of 30 inches, where it rests, with some variations in material, directly on consolidated or unconsolidated rock. The underlying rock may be shale, sandy shale, or fine-grained sandstone. Rayne silt loam is a comparatively dry soil.

Included with this soil as mapped are a few small areas in which the total soil mass is very thin. One of these bodies is 3 miles northwest of Fillmore, and another is 1½ miles southeast of Edri. A scattering of shale or sandy shale fragments may occur on the surface and throughout the soil mass, but these fragments are not so conspicuous as in Rayne shaly silt loam or Rayne gravelly silt loam.

Rayne silt loam occurs in the vicinities of Indiana, Crete, Georgeville, and Rossmoyne, and in many other places throughout the western half of the county. It occupies flat or gently rolling areas on the tops of ridges, divides, and more moderately inclined valley slopes. In most places, both surface and subsurface drainage are good, although in some local flat situations drainage is not thoroughly established. The surface relief is excellent for the use of all kinds of labor-saving machinery, and crops can be economically produced.

Nearly all, approximately 95 percent, of this soil is cleared and utilized for agricultural purposes, and the rest is in wood lots and brush. Various large oaks, hickory, maple, wild cherry, and beech constitute the tree growth. Where cultivated, the land is used for growing corn, wheat, rye, oats, potatoes, coarse forage, hay, pasture, garden truck, and fruit. Corn occupies about 12 percent, wheat 6 percent, oats 15 percent, rye 5 percent, buckwheat 7 percent, potatoes 2 percent, and hay and forage 26 percent of the cropland, and the rest is used for pasture, gardens, orchards, and other crops.

The reported acre yields of corn range from 30 to 50 bushels, wheat 25 to 35 bushels, oats 30 to 60 bushels, rye 15 to 35 bushels, buckwheat 20 to 30 bushels, potatoes 100 to 250 bushels, and hay 1 to 2 tons. Fruits and vegetables are said to do well. Rayne silt loam is an easy soil to work and is considered excellent for general farming. The soil is generally more acid than Westmoreland silt loam, and lime is applied regularly for correction.

Rayne gravelly silt loam.—The 8- to 10-inch surface soil of Rayne gravelly silt loam consists of yellowish-brown or dark-brown silt loam. This material passes gradually into compact silty clay loam or silty clay which in most places extends to a depth of more than 3 feet, where it rests on shale, sandy shale, or sandstone. This is the deepest soil of the Rayne series. The subsoil in general is buff, but it is not uniform in either color or texture. It is made up of light and heavy lenticular layers that change in texture from one extreme to the other within a short distance. Over the surface is a conspicuous quantity of flaggy shale and sandstone fragments which range from about 2 to 6 inches in diameter. A few rock fragments occur throughout the soil mass, most of which are more than 1 inch thick.

Rayne gravelly silt loam occurs in the central and western parts of the county. It is well developed near Reed, Indiana, Creekside, Gaibleton, Trade City, and Denton, and in many other places throughout the western part.

This soil occupies ridges and the more gentle slopes in the rolling or hilly country. It has good surface and subsurface drainage. The rock fragments interfere somewhat with cultivation and are rather hard on farm tools. About 60 percent of the land is utilized for crops, and the rest supports a mixed growth of various oaks, hickory, maple, elm, beech, and dogwood. Where cultivated, the land is used for corn, wheat, oats, rye, buckwheat, hay, and pasture. Corn occupies about 12 percent, wheat 8 percent, oats 10 percent, rye 5 percent, and buckwheat 6 percent of the cropland, and the rest is used for hay and pasture. The acre yields reported for corn range from 25 to 45 bushels, wheat 15 to 35 bushels, oats 25 to 60 bushels, rye 12 to 30 bushels, and hay 1 to 1½ tons. This is considered a strong soil for general farm crops, but the presence of so much fragmentary gravel on the surface has restricted its use.

Rayne stony silt loam.—The surface soil of Rayne stony silt loam consists of dark-brown or almost black silt loam, in few places exceeding a thickness of 10 inches. Below this is yellowish-brown or buff stony silty clay loam, which in many places extends to a depth below 24 inches. Interbedded with the subsoil material are lenses or layers of sandy clay loam, clay loam, or gritty clay loam. The surface is covered with large, irregular rocks of sandstone and conglomerate, many of which are embedded from 2 to 3 feet in the soil mass and could only be removed by blasting.

This soil occupies ridge tops and more gentle slopes, and it is largely covered with brush and timber consisting of various oaks, hickory, maple, elm, and beech. It occurs in the western part of the county, particularly east of Saltsburg, east of Conemaugh Church, north of Ernest, west of Ideal, northwest of McCormick, and along the western county line southwest of Smicksburg, also at other places throughout the county. The land has no agricultural value except to afford protection and scant pasture for livestock.

Rayne shaly silt loam.—The surface soil of Rayne shaly silt loam consists of an 8- or 10-inch layer of brown or dark-brown silt loam. This passes rather abruptly into buff or yellowish-brown light silty clay which in few places exceeds a depth of 20 inches. Below this layer the shale fragments are more abundant than the fine soil material and the material consists of yellowish-brown silt loam and

shale chips. This layer is underlain by bedrock of shale or sandy shale, which in most places lies within 3 feet of the surface. Over the surface and throughout the soil mass is a conspicuous quantity of shale chips, but they are not so abundant in the second layer as in the others.

Included in mapping are a few spots that have a similar profile, but the shale fragments on the surface and in the subsoil are very small, few being more than 1½ inches in diameter. This land has about the same agricultural value as the typical soil. One such spot occurs southwest of Indiana.

Most of Rayne shaly silt loam occurs in the central and northwestern parts of the county. In the western half, it is one of the more widely distributed soils. Its principal occurrences are in the vicinities of Crete, Indiana, Chambersville, Tanoma, Plumville, Rossmoyne, and Denton, in addition to many other places throughout the county.

This soil occupies low rolling and hilly country, more especially the tops of ridges, hills, and more gentle slopes. Surface and subsurface drainage are well established. The land warms up early in spring, and crops get an early start and mature earlier on this than on Rayne silt loam.

About 80 percent of the land is cleared and used for agricultural purposes, and the rest supports a mixed growth of large trees, such as various oaks, hickory, ash, wild cherry, dogwood, and some locust. The undergrowth consists of sassafras, dogwood, grapevines, and blackberry bushes. Where cultivated, the soil is used for the production of corn, wheat, oats, rye, buckwheat, potatoes, hay, garden truck and fruit. Corn occupies about 12 percent, wheat 9 percent, oats 10 percent, rye 5 percent, buckwheat 12 percent, and potatoes 3 percent of the cropland, and the rest is used for growing forage, hay, and pasture. The acre yields reported for corn range from 25 to 45 bushels, wheat 12 to 25 bushels, rye 15 to 25 bushels, oats 20 to 40 bushels, buckwheat 25 to 45 bushels, potatoes 100 to 250 bushels, and forage and hay 1 to 2 tons. Garden truck is early and said to be of good quality. Apples, peaches, pears, plums, and cherries are said to do well. This is an easy soil to work, and crops can be economically produced, as labor-saving equipment can be used.

Gilpin gravelly silt loam.—Gilpin gravelly silt loam has a brown or dark-brown mellow silt loam surface soil ranging from 5 to 10 inches in thickness. It is underlain by yellowish-brown silt loam, slightly heavier in texture and more compact in structure. This layer is variable in thickness and may extend to a depth of about 24 inches. It passes rather abruptly into buff or yellowish-brown light silty clay, which is decidedly lighter in color than that in the layer above and in few places exceeds a thickness of 5 inches, most of it, in fact, being only 2 inches thick. This layer rests on loose fragmentary shale or shaly sandstone, intermixed with which is a conspicuous quantity of mellow brown silt loam. In local spots throughout areas of this soil, the heavy layer is absent and the consolidated bedrock of sandy shale or shale lies within 40 inches of the surface. Over the surface and extending to the heavy layer is an abundance of flat shale fragments ranging from about 2 to 6 inches in diameter and from one-fourth to one-half inch in thickness.

Northwest of Dixon School, east of Blairsville, east of Kent, 3½ miles north of Graceton, northwest of Willet, and at other places throughout the western half of the county, are small areas of soil which consist of yellowish-brown or brown loam or silt loam to a depth ranging from 8 to 12 inches. This material passes into a 1- to 4-inch layer of light fine sandy clay or silty clay, and this, in turn, rests on shales or sandy shales intermixed with loam or silt loam. Bedrock of clay and arenaceous shales is present in most places below a depth ranging from 18 to 30 inches. Over the surface and throughout the soil mass is a conspicuous quantity of small angular fragments of shale or sandy shale, most of which are less than 2 inches in diameter. These fragments are much thicker than the shale chips in the shaly members of the Gilpin series. Included also are local spots, in which the fragments on the surface are fine-grained sandstone, the surface soil and subsoil are slightly sandy, and the surface texture is more nearly loam than silt loam.

Gilpin gravelly silt loam occurs in the western half of the county near Saltsburg, Blairsville, Kent, Shelocta, Smathers, Indiana, Willet, and Marion Center, and at other places throughout the county. It occupies hilltops, ridge crests, and more gentle slopes, and its surface relief is favorable to agricultural use. Both surface and subsurface drainage are good. Crops are said to do best on this soil in a wet year, but it has a high resistance to protracted dry spells or drought and has a better water-holding capacity than its structure would seem to indicate.

About 60 percent of the land is cleared, and the rest supports a mixed growth of various oaks, maple, wild cherry, hickory, and beech, accompanied by an undergrowth of dogwood and sassafras. The timber on this soil is not so large as that growing on the Rayne and Westmoreland soils. Where cultivated, the land is used for the production of corn, wheat, rye, oats, buckwheat, potatoes, hay, pasture, garden truck, and fruit. Corn occupies about 12 percent, wheat 7 percent, oats 15 percent, rye 8 percent, buckwheat 9 percent, and potatoes 3 percent of the cropland, and the rest is in hay and pasture. The reported acre yields for corn range from 30 to 50 bushels, wheat 12 to 20 bushels, oats 15 to 25 bushels, rye 15 to 25 bushels, buckwheat 20 to 30 bushels, potatoes 50 to 150 bushels, and hay or forage one-half to 1 ton. All kinds of garden truck do well, and considerable success is had with such fruits as apples, plums, and cherries. This soil warms up early in the spring, and crops mature early on it. It is not considered so difficult to work as Rayne gravelly silt loam, as the stone fragments are not so numerous and heavy.

Gilpin gravelly silt loam, steep phase.—Soil of the steep phase is in general similar to typical Gilpin gravelly silt loam, but it is more variable in thickness and includes more local variations. It occupies steep positions on valley slopes and hills and is exposed to serious wash and erosion, which in many places have been so severe as to expose the underlying bedrock or reduce the soil material to a mere cover. Soil of the steep phase has a wider distribution than typical Gilpin gravelly silt loam, but most of it occurs in the western half of the county. It is well developed near Indiana, Rayne, Saltsburg, Kent, Denton, Shelocta, and Creekside, and at other places throughout the county.

About 60 percent of this steep land is cleared, and the rest is in forest similar to that on the typical soil. Occasional crops of buckwheat and other grains are grown in the more favorable locations, but the greater part of the land is abandoned or utilized for pasture. Most of this land is too steep for agricultural use, and, where the soil is cultivated, nearly all the grain is harvested by hand, as machinery cannot be used. The pastures are generally scant unless the land is given some protection against erosion and wash, and where the land has been abandoned, vegetation may have some difficulty in getting a start. Some success has been attained with coniferous tree seedlings.

Gilpin stony loam.—Gilpin stony loam has an 8- to 10-inch surface soil of dark-brown or almost black loam. It is underlain by yellowish-brown slightly heavier compact silty loam which rests on lighter colored silty clay, sandy clay, or heavy loam ranging from 2 to 5 inches in thickness. This layer, in turn, rests on fragmentary shale or sandstone, which is superimposed on consolidated shale, sandstone, or conglomerate. Locally, the heavy layer is missing and the surface soil rests directly on fragmentary or consolidated rock. Scattered over the surface and embedded in the surface soil and subsoil, are numerous large irregular rocks of sandstone or conglomerate, many of which could only be removed by blasting.

This soil is of small extent and is restricted to the western part of the county, south of Black Lick, southeast of Campbells Mill, south and southeast of Creekside, and in other small spots.

It occupies ridge crests and more gentle slopes and is well drained. Practically all the soil is forested with various oaks, hickory, elm, maple, beech, dogwood, and wild cherry, accompanied by an undergrowth of brush. The land has no agricultural value other than affording protection and scant pasture for livestock. The rocks on the surface preclude cultivation.

Gilpin stony loam, steep phase.—The steep phase of Gilpin stony loam has the general characteristics of the typical soil, but it is more variable in thickness and occupies steep slopes. In addition to the large loose rock fragments on the surface it contains many outcrops of bedrock. In places the texture is very silty.

Soil of this phase occurs in the western half of the county north of Fillmore, north of Blairsville, north of Saltsburg, on the west slopes of Two Lick Creek, along the steep slopes of Mahoning Creek, and in many other places.

All this land is forested and has no agricultural value except for forest products. It affords protection and scant pasture for livestock.

Gilpin gravelly sandy loam.—The surface soil of Gilpin gravelly sandy loam consists of grayish-brown or dark-brown sandy loam about 10 inches thick. This passes into buff or yellowish-brown heavy sandy loam or light sandy clay, which, below a depth of 24 inches, becomes medium loamy sand or sand, and this material, in turn, rests on sandstone within a depth of 40 inches. Conspicuous quantities of sandstone fragments, more than one-half inch thick and ranging from 2 to 6 inches in diameter, are scattered over the surface, and some fragments are scattered throughout the soil mass.

Included with this soil in mapping, on account of their small extent, are a few small areas of Gilpin sandy loam, which occur between Gilpin and Indiana. This soil is similar to Gilpin gravelly sandy loam, but rock fragments are not conspicuous on the surface. It occupies similar topographic positions, has similar drainage, and is used for similar purposes, but it is an easier soil to work.

Gilpin gravelly sandy loam occurs in the western part of the county, particularly between Indiana and Gilpin, southeast of Gilpin, and northwest of Chambersville.

The surface relief is favorable for agricultural use, and the soil occupies the tops of ridges and more gentle slopes. It has good surface and subsurface drainage; in fact the subsurface movement of moisture is too rapid in places, and crops suffer during protracted dry spells. About 70 percent of this soil is cleared, and the rest supports a mixed growth of various oaks, hickory, wild cherry, beech, poplar, sassafras, and dogwood. Where cultivated, the land is used for the production of corn, wheat, rye, oats, buckwheat, potatoes, hay, and pasture. Corn occupies 12 percent, wheat 8 percent, oats 16 percent, rye 5 percent, buckwheat 8 percent, and potatoes 3 percent of the cropland, and the rest is in hay and pasture. The acre yields of corn range from 25 to 45 bushels, wheat 12 to 25 bushels, oats 20 to 35 bushels, buckwheat 20 to 30 bushels, rye 15 to 30 bushels, potatoes 70 to 150 bushels, and hay 1 to 1½ tons.

This soil warms up early, and crops can be harvested earlier than on Rayne gravelly silt loam. The land can also be worked sooner after rains. The pastures are not quite so good or persistent, but the soil is better adapted to light farming or to the production of garden truck and fruit.

Gilpin shaly silt loam.—The 7- to 10-inch surface soil of Gilpin shaly silt loam consists of grayish-brown silt loam containing a conspicuous quantity of small thin shale chips on the surface and throughout the surface soil. This layer on unconsolidated shale fragments intermixed with brown silt loam, and, in most places below a depth of 24 inches, passes into consolidated bedrock of gray, brown, or reddish-brown mud shales.

Gilpin shaly silt loam is one of the less extensive soils in Indiana County. It occurs east of Saltsburg, south of Indiana, west of Onberg, north of Kintersburg, north and northeast of Gilpin, north of Sample Run, east of Home, and northeast of Ideal, and in other small spots throughout the county.

This soil occupies the tops of ridges and more gentle slopes. It has good surface and subsurface drainage but has poor water-holding capacity, and crops suffer during long-continued dry spells. About 90 percent of the land is cleared, and the rest supports a mixed growth of various oaks, maple, hickory, dogwood, and wild cherry. Where farmed, corn, wheat, oats, rye, buckwheat, potatoes, and hay and forage are the principal crops. Corn occupies about 12 percent, wheat 9 percent, oats 14 percent, rye 9 percent, buckwheat 13 percent, and potatoes 8 percent of the cropland. The acre yields reported for corn range from 25 to 40 bushels, wheat 12 to 20 bushels, rye 12 to 15 bushels, potatoes 100 to 250 bushels, and hay and forage 1 to 1½ tons.

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Gilpin shaly silt loam is an easy soil to work. The small shale chips on and through the soil do not interfere with cultivation, the land warms up early, and crops mature early. This is considered a good soil for potatoes, truck, and fruit.

Gilpin shaly silt loam, steep phase.—The steep phase of Gilpin shaly silt loam has the same general characteristics as the typical soil, with the exception that it is more shallow and occupies steeper situations. It is one of the extensive soils of the county. It occurs in the vicinities of Indiana and Denton, near and southwest of Willet, north of Onberg and Sharpsburg, and in other places throughout the county.

In most places drainage is excessive, and, although more than 50 percent of the land is cleared, little of it is used for crops. Where farmed, patches of rye and buckwheat are the principal crops, and these are harvested by hand with a cradle, as improved machinery cannot be used. Much of the cleared land is in pasture.

DEKALB GROUP

The soils of the Dekalb group have gray or dark-brown surface soils and yellow or buff subsoils. This group includes all the types of the Dekalb, Leetonia, and Clymer series, and most of the rough stony land. The total area occupied by soils of the Dekalb group is 300.2 square miles, or 36.2 percent of the area of the county. These soils are restricted largely to the eastern half. They occur in broader areas than the soils of the Westmoreland or Rayne groups, and they are not so spotted and mixed. They are, however, not continuous but are interrupted by members of this and other groups.

These soils occupy high rolling country having considerable range in surface relief. Most of them have good surface and subsurface drainage. The surface soils range in texture from sandy loam to silt loam. The subsoils range from light sandy loam to rather heavy sandy clay loam, and the color ranges from yellow to buff. In most places, the parent rock material occurs within 40 inches of the surface.

All these soils, where forested, have one characteristic in common—a covering of organic matter that is generally black and may be 2 or 3 inches thick. In most places it can be rolled up like a mat or carpet. Along the roadsides and road cuts in more undisturbed sections, the influence of this organic layer is seen in the distinct dark-gray color of the surface soil. The presence of this organic layer on the steeper slopes has to a great measure retarded erosion, as it acts much like a sponge.

All the soils of this group range from acid to strongly acid in reaction. When first cleared, they are said to be almost unproductive and yields of crops are very low, but they can be developed into productive soils by careful management, intelligent use of lime and fertilizer, and proper crop rotations.

The difference in the productivity of the soils of this group as compared with the soils of the Rayne group can be explained by local differences in native vegetation and climate. Soils in both groups have the same parent rock material, yet the soils of one group are strong and productive when the trees and brush have

been removed, whereas the soils of the other group are weak and unproductive. The difference is further emphasized by differences in the general character of the vegetation. The soils of the Rayne group support a timber growth, largely of hardwoods, which attain considerable size. The presence of sugar maple, so abundant on the soils of this group, was one reason why these lands were first used by the early settlers. The original timber on the soils of the Dekalb group was prevailingly hemlock, pine, and chestnut. Many of these trees were large but not so large as the hardwoods on soils of the other groups. The differences in the character of the undergrowth are also conspicuous. Laurel, huckleberry, rhododendron, and groundpine predominate on the soils of the Dekalb group, and sassafras and dogwood on the soils of the Rayne group. Other factors that emphasize the climatic difference are the high average altitude of the soils of the Dekalb group, the greater rain and snowfall, and the greater prevalence of fogs.

Agricultural activities are more diversified on the soils of the Dekalb group in the north-central part of the section occupied by this group, and there is more dairying and general farming, but this feature can be attributed to some extent to the fact that the country is not so inaccessible. In the southern part of the section less agricultural development has taken place, and the patchy farming is of a more general type.

Clymer gravelly silt loam.—The 10-inch surface soil of Clymer gravelly silt loam in forested areas consists of a mat of leaves and forest debris overlying a thin layer of dark-brown granular loam containing considerable organic matter, which gradually changes to yellowish-brown friable silt loam. The subsoil, between depths of 10 and 40 inches, is yellowish-brown or pale yellowish-brown friable silt loam which, below a depth of 40 inches changes to friable pale yellowish-brown light loam or sandy loam, resting on bedrock of partly disintegrated sandstone. The entire soil mass is firm but not compact, and it contains many fragments of sandstone rock. The soil material is acid throughout.

Clymer gravelly silt loam is an extensive soil in this county, covering an aggregate area of 63.1 square miles. It occurs near Deckers Point, Hillsdale, Smithport, Arcadia, Purchase Line, Beringer, and Alverda, northwest of Juneau, northwest of Mitchells Mills, east of Pine Flats, southeast and northeast of Homer City, east of Graceton, east of Clymer, northeast of Kellers Mill, west of Heilwood, east and south of Strongstown, near Cramer, Dilltown, and Buffington, and at many other places throughout the eastern half.

This soil has favorable surface relief, and most of it occurs on the tops of ridges and on the moderate slopes. It has good surface and subsurface drainage and a water-holding capacity much greater than the Gilpin or Dekalb soils and about the same as Clymer silt loam.

About 50 percent of the land is cleared and utilized for crops, and the rest supports a mixed growth of various small oaks, maple, wild cherry, birch, hickory, pine, and hemlock, together with an undergrowth of huckleberry, laurel, teaberry, and groundpine. Cropped areas are used for corn, wheat, oats, rye, buckwheat, hay, and pasture. Corn occupies about 15 percent of the cropland, wheat 9 percent, oats 25 percent, rye 7 percent, and buckwheat 12 percent, and the rest is in hay and pasture. The acre yields reported for

corn range from 12 to 30 bushels, wheat 10 to 15 bushels, oats 15 to 40 bushels, rye 12 to 18 bushels, buckwheat 15 to 35 bushels, and hay one-half to 1½ tons. Yields are generally low, but the soil is said to respond to the use of lime and superphosphates, as most of it is very acid. The rock fragments on the surface interfere somewhat with cultivation and are especially hard on tools. This soil is considered more difficult to till than the Dekalb soils or Clymer shaly silt loam.

Clymer silt loam.—Clymer silt loam is similar to Clymer gravelly silt loam, with the exception that the surface and soil mass are practically free of rock fragments. It is a comparatively deep soil, but a few small areas are included in which the soil mass is comparatively shallow. One such body is 2 miles southeast of Luciusboro, and one is 2 miles west of Strongs Hill, where the soil occupies the tops of ridges and more gentle slopes. The land has good surface and subsurface drainage and an excellent water-holding capacity, and crops do not suffer much in protracted dry spells. This is an easier soil to work than Clymer gravelly silt loam and in this respect is considered a more valuable soil. It is of rather small extent. It occurs west of Rexis, north of Wehrum, southwest of Buffington, east of Bowdertown, southeast of Kellers Mill, in the vicinity of Pikes Peak and Martintown, and at other places throughout the eastern half of the county.

This soil has a productive value similar, in general, to that of Clymer gravelly silt loam, but it is easier to handle and seems to be slightly more productive.

Clymer shaly silt loam.—As typically developed, Clymer shaly silt loam consists of gray or brown silt loam to a depth of about 10 inches, where it is rather abruptly underlain by pale-yellow silty clay. The clay layer ranges from 10 to 15 inches in thickness and rests on unconsolidated yellowish-brown mud shale fragments, between which is a slight quantity of yellow or yellowish-brown silt loam. This layer in few places extends below a depth of 30 inches, and it is underlain by a consolidated mud shale of yellow, gray, brown, or reddish-brown color, through which many black seams of coal occur. Over the surface and scattered through the surface soil are numerous small thin shale fragments ranging from one-fourth inch to 1½ inches in diameter and less than one-fourth inch thick, and the second, or heavy, layer contains a few shale fragments. The quantity of these chips is not so great as in Dekalb shaly silt loam.

Clymer shaly silt loam is an extensive soil. It occurs northeast of Cramer, southeast of Croft, south and east of Nolo, north and east of Evans Hill, east of North Summit, south of Rossiter, northeast of Arcadia, in the vicinities of Pineton, Heilwood, Pikes Peak, Purchase Line, and Taylorsville, and at many other places throughout the eastern half of the county.

The surface relief in general is favorable for agricultural use, as the soil occupies the tops of ridges and the more gentle slopes. Both surface and internal drainage are well established. The water-holding capacity of this soil is very good, and crops rarely suffer from drought, unless the dry spell is unusually prolonged.

About 60 percent of this soil is cleared and farmed, and the rest supports a mixed growth of hemlock, pine, small oaks, hickory, maple,

and wild cherry. There is a definite layer of fibrous humus on the surface of forested areas, but the undergrowth contains less teaberry and groundpine than that on other members of this group.

Where cultivated this soil is used for the production of corn, wheat, oats, buckwheat, potatoes, hay, and pasture. Corn occupies about 15 percent, wheat 10 percent, oats 12 percent, buckwheat 14 percent, and potatoes 4 percent of the cropland, and the rest is used for hay and pasture. The acre yields reported for corn range from 20 to 35 bushels, wheat 10 to 25 bushels, oats 15 to 35 bushels, buckwheat 15 to 40 bushels, potatoes 50 to 150 bushels, and hay 1 to 1½ tons. All kinds of fruit and vegetables are said to do well.

Clymer shaly silt loam is an easy soil to work. The small fragments or chips of shale do not interfere with cultivation or cause much wear on tools. Although this is considered an early soil, crops cannot be planted or harvested so early as on Gilpin shaly silt loam.

Clymer stony silt loam.—Clymer stony silt loam ranges from stony sandy loam to stony silt loam in the surface soil and subsoil. It is a little deeper soil than Clymer shaly silt loam but has the same restricted agricultural value as other stony loams. This soil occurs north of Armagh, southeast of Brush Valley, southeast and north of Homer City, east and west of Graceton, northwest of Evans Hill, near Wehrum, and at other places in the eastern half of the county.

Dekalb gravelly silt loam.—The 8- to 12-inch surface soil of Dekalb gravelly silt loam consists of gray or brown loam or silt loam. It is rather abruptly underlain by a layer of light fine sandy clay or light silty clay which in few places extends to a depth of 20 inches and in many places is only 6 or 8 inches thick and passes into unconsolidated mud and arenaceous shales mixed with loam or silt loam. This layer rests directly on bedrock of shales or sandy shales, generally within a depth of 30 inches. Over the surface and throughout the soil mass is a conspicuous quantity of small angular fragments of shale or sandy shale. Few of these fragments are more than 2 inches in diameter, but they are much thicker and more blocky than the shale chips in the Clymer soils. Locally, the fragments are sandstone, and the surface soil and subsurface soil are more sandy.

Areas of Dekalb gravelly silt loam occur near Doty Roundtop, east and south of Rossiter, northwest of Locust Lane, north and south of Smithport, south of Wilgus, west of Rexis, south of Commodore, and near Kinter Hill. The largest bodies are south of Black Lick and northeast of Josephine. The areas in the eastern half of the county have an abundance of shale fragments, from 2 to 6 inches in diameter and between one-half and one-fourth inch thick, scattered over the surface and extending through the soil mass.

This soil occupies ridge tops and the more gentle slopes, and it has good surface and subsurface drainage. The water-holding capacity is said to be only fair, and crops suffer during prolonged dry spells. More than one-half of the land is cleared and farmed, and the rest supports a mixed growth of small oaks, hickory, birch, wild cherry, chestnut, pine, and hemlock, together with an undergrowth of huckleberry, laurel, teaberry, and groundpine.

The cultivated land is used for corn, wheat, oats, buckwheat, hay, and pasture. Corn occupies about 12 percent, wheat 10 percent, oats

16 percent, and buckwheat 15 percent of the cultivated land, and the rest is in hay and pasture. The acre yields reported for corn range from 12 to 35 bushels, wheat 10 to 15 bushels, oats 12 to 20 bushels, buckwheat 15 to 30 bushels, and hay one-half to 1 ton. The grasses in the pastures are said to be scant and not persistent.

Dekalb gravelly silt loam is an easy soil to work, and most farmers prefer it to Clymer gravelly silt loam. It warms up early, and crops mature early. The soil is acid, but this condition is being corrected with lime. Where improved, this soil should be valuable for truck and fruit crops.

Dekalb gravelly silt loam, steep phase.—The steep phase of Dekalb gravelly silt loam has the same general characteristics as the typical soil, with the exception that, in most places, it is shallower and occupies steep positions. Most of this steep land is forested, and little of it is used for agricultural purposes other than for pasture or for growing coniferous tree seedlings. The cleared spots are patchlike, and, where farmed, some small grain is grown which is usually harvested by hand, as improved machinery cannot be used. The presence of raw humus and rock fragments seem to offer considerable resistance to erosion. This soil is more difficult to work than typical Dekalb gravelly silt loam, and the shale fragments are harder on farm tools.

Dekalb gravelly sandy loam.—Dekalb gravelly sandy loam has a gray or dark-gray surface soil ranging from 5 to 8 inches in thickness. This rests on yellow light sandy clay or heavy sandy loam, which in few places extends below a depth of 24 inches, where it becomes yellow loamy sand or sand. This material rests directly on the underlying bedrock of sandstone. Over the surface and scattered irregularly throughout the soil mass are many sandstone fragments which range from about 2 to 5 inches in diameter. These are more nearly round than the cobbles in the Rayne and Gilpin soils, which are, for the most part, flaggy in character.

Included with this soil in mapping, on account of their small extent, are a few spots of a shallow phase. Such areas occur 2 miles northwest of Brush Valley and northwest of Wilgus. Also included are a few areas that are similar to the typical soil in texture and structure, but the soil material is slightly darker and more brown in the surface layer, more buff rather than yellow in the lower soil layers, and the heavy part of the subsoil is generally thicker. Such areas occur west of Locust, west and southwest of Wilgus, on the county line north of Cherrytree, and west of Buck Hill. Areas of this kind are largely cleared and under cultivation, and they seem to be slightly more productive than typical Dekalb gravelly sandy loam. Also included are a few small areas that differ from Dekalb gravelly sandy loam in that the surface soil and subsoil are in most places free of rock fragments. Both layers are slightly darker, and the heavy part of the subsoil is somewhat thicker. Small spots of this kind lie northeast of Purchase Line, near Cherrytree, and northeast of Beringer.

Only a small proportion of Dekalb gravelly sandy loam is utilized for agricultural purposes, probably not more than 10 percent, and the rest supports a forest growth similar to that on Leetonia gravelly sandy loam. Where farmed, corn, oats, rye, buckwheat, and

hay are grown. Corn occupies about 12 percent, wheat 4 percent, oats 10 percent, rye 9 percent, and buckwheat 8 percent of the cropland, and the rest is used for hay and forage. Acre yields of corn range from 12 to 15 bushels, wheat 10 to 12 bushels, oats 15 to 25 bushels, rye 20 to 25 bushels, and buckwheat 20 to 30 bushels. Forage and hay yield about 1 ton each.

This soil is said to be practically unproductive when first cleared, but, with the use of lime and superphosphate, good crops can be obtained. The rock fragments on the surface interfere somewhat with cultivation, and in some places an effort has been made to remove them, as shown by many rock heaps. The land warms up early in the spring. It requires considerable moisture, and crops are said to suffer during protracted dry spells.

Dekalb shaly silt loam.—As typically developed, Dekalb shaly silt loam consists of gray or brown silt loam to a depth of about 10 inches. This material passes into unconsolidated shale fragments, between which is a slight quantity of brown silt loam, and this layer, in turn, within a depth of 30 inches, rests on consolidated shale beds ranging in color from gray to almost red. Over the surface and throughout the surface soil are many thin shale fragments ranging in diameter from one-fourth inch to 1½ inches, most of which are less than one-eighth inch thick.

Dekalb shaly silt loam is one of the less extensive soils. It occurs in small areas northwest of Cramer, north of Grisemore, east of Robertsville, south of Glen Campbell, southeast of Canoeridge, west of Suncliff, southwest of Pineton, northeast of Mitchells Mills, and near Turkey Knob.

This soil occupies the tops of narrow ridges, knobs, and more gentle slopes, and it has good surface and subsurface drainage. It has poor water-holding capacity, and crops suffer during protracted dry spells. About 60 percent of the land is cleared, and the rest supports a mixed growth of small oaks, hickory, maple, wild cherry, chestnut, pine, and hemlock, with an undergrowth of huckleberry, laurel, teaberry, and groundpine.

The cultivated land is used for corn, wheat, oats, buckwheat, potatoes, and hay. The acre yields reported for corn range from 10 to 25 bushels, wheat 10 to 20 bushels, oats 15 to 30 bushels, buckwheat 20 to 35 bushels, potatoes 50 to 100 bushels, and hay one-half to 1 ton. All kinds of garden truck, apples, cherries, and plums do well.

This soil is easy to work. It warms up early in the spring, and crops mature early. It can be worked sooner after rains than most of the soils of the county and is considered a good soil for truck and fruit in seasons of normal rainfall.

Dekalb shaly silt loam, steep phase.—The steep phase of Dekalb shaly silt loam has the same general characteristics as typical Dekalb shaly silt loam, but in most places the thickness of the soil material is less. It occupies steep positions and, as a result of soil washing, the underlying bedrock is exposed in places, and in other places the heavy layer is lacking.

Soil of this phase is fairly extensive. It occurs near Heilwood, Buck Hill, Spruce, and Cramer, east of Dixonville, north of Mitchells Mills, northeast of Pineton, and at other places throughout the eastern part of the county.

About three-fourths of the land is covered with timber and brush similar to that on the typical soil, and the rest is used for pasture and patches of small grain or represents areas turned out for reforestation. Most of the surface is too steep for the economic growth of crops, and when small grain is produced most of it is harvested by hand.

Dekalb stony loam.—The areas of Dekalb stony loam are more shallow, as regards the total thickness of the surface soil and subsoil, and they have a larger quantity of outcropping rock on the surface than the other Dekalb soils. The surface relief ranges from gently rolling to rolling, and most of this soil occurs on the tops and more gentle slopes of the highest uplands.

Most of this soil is covered with timber and brush and has no value except for mine timbers and props and other forest products, although it provides some pasture and protection for livestock. The tree growth is similar to that on Dekalb gravelly sandy loam.

Dekalb stony loam, as typically developed, occurs in the eastern half of the county, southeast of Graceton, southeast of Black Lick, north of Kellers Mill, southeast of Homer City, and at other places throughout this section.

Dekalb stony silt loam.—The surface soil of Dekalb stony silt loam consists of gray, dark-gray, or brown silt loam from 5 to 10 inches thick. This material passes rather gradually into yellow or buff compact silty clay loam or silty clay, which, within a depth of 40 inches, rests on shale, sandy shale, or sandstone. The subsurface material is not everywhere uniform in color or structure. In some places the clay layers have a pink cast or a dull-brown color. The textural differences are due to light and heavy lenticular layers that change in texture from one extreme to the other within short distances. This soil averages thicker than most of the Dekalb soils. The surface is conspicuously strewn with flaggy fragments of shale and sandstone, which range from 2 to 6 inches in diameter and from 1 to 1½ inches in thickness. Rock fragments are scattered in some places and concentrated in others on the surface and through the soil mass.

Dekalb stony silt loam, steep phase.—Dekalb stony silt loam, steep phase, consists of silty surface soil and subsurface soil material, but has the same restricted agricultural utilization as the other stony steep soil phases of this county. Areas occur south and east of Brush Valley, south of Armagh, and along the east slopes of Two Lick Creek.

Leetonia gravelly sandy loam.—The surface soil of Leetonia gravelly sandy loam consists of gray, dark-gray, or almost black sandy loam to a depth ranging from 5 to 8 inches. This rests on yellow or buff rather compact sandy loam or light sandy clay, which in few places extends beyond a depth of 24 inches, where it passes into yellow sandy loam or loamy sand. This material, in turn, is underlain by gray sandstone bedrock which is present, in most places, between depths of 25 and 40 inches.

This soil has a high content of organic matter, and in places this material gives the surface soil a more loamy texture. Undisturbed areas have a thick mat of humus on the surface and a thin dark-

brown layer at the base of the surface soil, and in cultivated fields the turning up of this dark material has given a decided brown cast to the surface soil. Where, however, the fields have been in cultivation for a long time this color gives way to gray.

Leetonia gravelly sandy loam occurs east of Cramer, in the vicinity of Blaides, east, northeast, and south of Pineton, northeast of Homer City, and near Juneau, North Summit, Reisinger School, and Heshbon. It occupies the higher parts of the uplands. The surface relief ranges from undulating to rolling, and both surface and subsurface drainage are good.

Very little of the land has been cleared and farmed, probably not more than 5 percent. The cleared areas are small patches needed to round out or square a field for more economic handling. The rest of the land supports a mixed growth of wild cherry, maple, hickory, various small oaks, poplar, pine, and hemlock. Nearly all the trees are small, and in places there are rather large chestnut stumps. The undergrowth contains a conspicuous quantity of young chestnut, laurel, huckleberry, groundpine, and teaberry.

Farming on this land is restricted to the minimum, as the soil is recognized as poor and unproductive. Acre yields of corn rarely exceed 12 bushels. The soil is very acid, and it is cropped only where absolutely necessary.

Leetonia gravelly sandy loam, steep phase.—The only difference between Leetonia gravelly sandy loam, steep phase, and the typical soil is that the steep phase occupies steeper slopes and crops cannot be so economically grown. Two areas of this steep land occur on the county line east of Cramer.

Leetonia stony sandy loam.—The 6- to 10-inch surface soil of Leetonia stony sandy loam consists of dark-gray or almost black sandy loam. It is underlain by yellow or dull-yellow light sandy clay or heavy sandy loam, which may extend to a depth of about 20 inches, where the material becomes lighter in texture and is more nearly loamy sand or sandy loam. This material rests on bedrock of gray sandstone, usually within a depth of 30 inches. In places the surface soil and upper part of the subsoil contain some very small rounded gravel which give the soil material a gritty character. In such places the parent soil material was derived from conglomerate

Detached large rock fragments are scattered over the surface. Some are embedded in the soil mass and could only be removed by blasting, and others are outcropping bedrock.

Most of Leetonia stony sandy loam occurs in the eastern part of the county. The areas are generally broader and larger than those of members of other groups. Bodies occur near Reisinger School and Clyde, east and south of Pineton, near Croft, west of Sidney, and at other places throughout the eastern part of the county.

Leetonia stony sandy loam occupies the tops of ridges and more gentle slopes, and it has good surface and subsurface drainage. Practically all this land is in forest similar to that on Leetonia gravelly sandy loam. The soil has no agricultural value other than to afford protection and scant pasture for livestock.

Leetonia stony sandy loam, steep phase.—Leetonia stony sandy loam, steep phase, has the same general characteristics as Leetonia

stony sandy loam, except that the total thickness of soil material is in most places less. It also occupies steeper positions and has a greater proportion of outcropping rocks.

It occurs only in the eastern part of the county, particularly southeast of Cramer, east of Homer City, south of Nolo, east of Kellers Mill, south of Croft, and at other places throughout this section.

Most of the areas of Leetonia stony sandy loam, steep phase, and included variations, are steep and in many places rough and broken. The soil has no value other than for mineral and forest products. Where it occurs contiguous to farms it affords protection and scant pasture for livestock.

Rough stony land.—Rough stony land represents land too steep, rough, or broken for agricultural use. It consists of areas covered with loose and outcropping rocks of all sizes. The surface relief in many places is blufflike or precipitous, as in the areas near the eastern county line along Conemaugh River and Blacklick Creek, but the land is not quite so steep where it occurs in other places along Blacklick Creek, and along Yellow Creek, Two Lick Creek, and Mahoning Creek.

The soil materials range from sandy or gritty loams to heavy silt loams. The rocks are dominantly gray and yellow sandstones, conglomerates, and shales. Red shales and sandstones are exposed in places, but not in areas of sufficient size to justify their separation on the map. One of the largest red shale and sandstone areas occurs near the mouth of Blacklick Creek northwest of Blairsville.

Most of the rough stony land is covered with timber and brush similar in most respects to that growing on the other soils of this group. In most places there is a matlike covering of raw humus on the surface, in some places as much as 3 inches thick. In the western part of the county, the matlike characteristics are not conspicuous. This rough land has no value except for mineral and forest products. In places it affords scant pasture and protection for livestock.

IMPERFECTLY DRAINED SOILS

The imperfectly drained soils have gray or brown surface soils and yellow or brownish-yellow subsoils. They have been subdivided into two divisions—the imperfectly drained soils of the uplands and the imperfectly drained soils of the bottoms and terraces. The first division includes soils and phases of the Cavode, Ernest, Monongahela, and Cookport series, and the second division, members of the Pope series. The imperfect drainage of soils of both divisions is not always easily apparent, as it may be due either to internal conditions of soil structure or external conditions of relief, position with respect to water table, or frequent and uncertain overflows or inundations. Such soils have a restricted agricultural use.

Cookport silt loam.—The surface soil of Cookport silt loam consists of gray or dark-gray rather compact silt loam ranging from 5 to 10 inches in thickness. Below this the material becomes slightly heavier, or light silty clay loam, in texture, and is of pale-yellow color. Between depths of 15 and 20 inches the material becomes pale-yellow compact silty clay with faint mottlings of gray. It becomes heavier and more compact with depth and more definitely and intensely mottled with gray and brown, the gray predominating. Be-

tween depths of 30 and 50 inches the soil material rests on a hard brittle indurated layer, or hardpan, in which the predominant color is brown or dark brown, and there are distinct mottlings of gray and yellow. This layer is variable in thickness, and a layer lighter in color and texture, ranging from sandy loam to silt loam, occurs between it and bedrock. The underlying bedrock is gray sandstone or gray, yellow, or reddish-brown shale.

Locally, spots containing gravel occur throughout the areas of Cookport silt loam, but these bodies are not large enough to separate on the map. The only difference between these spots and the typical soil is the occurrence of angular fragments of sandstone and sandy shales which are scattered conspiciously over the surface and occur in places throughout the soil mass. Most of the fragments are flaggy or flat, from 2 to 6 inches in diameter, and about 1 inch thick. The total depth of soil material in such spots is less than in other places. The stone fragments do not interfere much with cultivation. The stony land has about the same productivity as typical Cookport silt loam and is used in much the same way. It occurs southwest, south and southeast of Kenwood, in the vicinity of Strongstown, and southeast of Blaides.

Cookport silt loam is a rather extensive soil. It occurs principally in the vicinities of Kenwood, Pine Flats, Cookport, Rossmoyne, and Marchand, southwest of Smicksburg, and at many other places throughout the eastern and northern parts of the county.

Most of the soil occupies flat or gently undulating parts of the higher uplands. The water table is rather close to the surface, and some effort has been made by open ditching and tiling to give the soil material better drainage. Rain water remains on the surface for several days after heavy rains.

About 70 percent of the land is cleared, and the rest supports a mixed growth of pine, hemlock, beech, maple, various oaks, and hickory, together with an undergrowth of ferns, wintergreen, and moss. The organic layer is, in general, black, thick, and matlike. In the western part of the county the tree growth is principally oak, hickory, maple, beech, and wild cherry, and here the organic matter is not so matlike.

The cleared land is used for the production of corn, oats, hay, and pasture. Corn occupies about 15 percent of the cultivated land, oats 10 percent, hay about 40 percent, and the rest is in pasture. Acre yields of corn range from 25 to 45 bushels, oats 20 to 40 bushels, and hay 1 to 2 tons. If the season is wet, crops are in general poor. Wheat and rye are not often sown, as they are said to winterkill easily. Pastures on this soil are said to be good in places where drainage has been improved.

Cookport silt loam, poorly drained phase.—Poorly drained areas of Cookport silt loam have been differentiated as a poorly drained phase of that soil. This material represents a transition between the Lickdale soils on the one hand and the Cookport soils on the other, and in many places it occurs between the two. Soil of this phase is similar to the typical soil, but the uniformly pale yellow layer below the surface of the soil is missing, the mottled layer comes to the bottom of the surface soil, and the hardpan or indurated layer, in most places, occurs within a depth of 30 inches below

the surface. Drainage is not so well established in this as in the typical soil, and crops are successfully grown only in dry seasons. This soil occurs in the vicinity and southeast of Cookport, and north of Pine Flats. The surface of an area east of Cookport along a small stream is covered with large stones.

Cavode silt loam.—As typically developed Cavode silt loam consists of grayish-brown or brown silt or heavy silt loam about 10 inches thick. This layer is rather abruptly underlain by uniformly yellow silty clay which ranges in thickness from about 3 to 8 inches and rests on yellow, mottled with gray and brown, compact sticky heavy silty clay which in most places extends to a depth of 40 or more inches. In places the clay is splotched with streaks of red or brown, some of which are 8 or 10 inches wide. In other places the mottled layer rests on whitish-gray clay. In general, however, the color of the lower part of the material seems to be directly influenced by the underlying rocks which may be red or yellow shales, gray sandstone, or fine clay.

Included with Cavode silt loam as mapped are a few bodies of Cavode stony silt loam which are too small to separate. Areas of this stony soil lie 3 miles southwest of Onberg.

Cavode silt loam is one of the less extensive soils of the county. It occurs in very small areas in the western part, 3½ miles northeast of Indiana, near Marchand, and around Smicksburg. In general, it occupies positions favorable for agricultural utilization, mainly on ridges or more gentle slopes. Surface drainage is in general fair, but in places where the surface is flat, water remains a long time after rains. When the subsoil is thoroughly wet it remains so for a long time, but when it becomes thoroughly dry, as on slopes, it seems to shed the water rather than to absorb it readily. In this respect the soil is uncertain and very difficult to handle. If plowed too dry it breaks up in large clods, and if plowed too wet it balls up and does not scour readily from the plow. This may be the reason that so little of this land is utilized for crop production after the timber has been removed.

The poorly drained areas associated with Cavode silt loam differ from the typical soil in that the uniformly yellow layer below the surface soil is missing, and the surface soil rests directly on the mottled layer. Such areas have about the same value and agricultural use as typical Cavode silt loam. They occur 3½ miles north of Tunnelton, 4 miles northeast of Indiana, and 3 miles southwest of Crete. In places the soil has a noticeable quantity of flaggy shale or sandstone fragments scattered over the surface.

Probably 60 percent of Cavode silt loam is cleared, and the rest supports a mixed growth of oak, maple, and wild cherry, together with a few poplar, birch, sassafras, hemlock, and pine. Only a very small proportion of the cleared land is used for crops, and that only in patches. The soil is uncertain because of its slowness in drying in the spring. Occasionally a crop of corn is successfully grown under favorable conditions, and yields reported range from 12 to 35 bushels. The small grains are more uncertain and generally winter-kill. Most of the land is used for pasture, which is only fair, as the soil is very acid. Lime and superphosphate are said to improve the physical and chemical condition of this soil.

Ernest silt loam.—As typically developed Ernest silt loam consists of yellowish-brown or dark-brown mellow silt loam to a depth of 8 or 10 inches. This material passes rather abruptly into yellow light silty clay which extends to a depth of 12 or 15 inches. This layer, in turn, rests on yellow silty clay, with gray, dark-yellow, and brown mottling, which usually extends to a depth of about 30 inches where it is underlain by a darker and harder layer of gritty clay loam (or hardpan). This material is dark brown and intricately mottled with gray, brown, yellow, and black; it is brittle; and it lacks definite cleavage. In places this layer is 2 feet thick and usually rests on gray clay splotched with yellow and brown. Locally, where seepage is common and where the soil has been subjected to wash or erosion the uniform yellow layer is absent and the mottled clay comes to the base of the surface soil. This is one of the deep soils of the county and has been developed largely from material washed from higher lying land. Little fragmentary rock is scattered over the surface, but red fragments, which may be sandstone, sandy shales, or shales, are generally scattered throughout the lower part of the soil.

In the vicinity of Boltz, east of North Point, and along Cushion Creek west of Cherrytree are areas of this soil containing many pebbles, and south and southwest of Mechanicsburg and along Two Lick Creek are areas having some stones on the surface.

Practically all of Ernest silt loam occurs on the lower slopes to streams and watercourses. It is a fairly extensive soil. It is well developed in all parts of the county except the southwestern, and most of it lies just above the bottoms and along the lower valley slopes of most of the streams.

This soil is subjected to more or less seepage, and in wet seasons small springs develop that keep the soil in places wet and soggy. Probably 50 percent of the land has been cleared, and the rest supports a tree growth, principally of various large oaks, some hickory, maple, wild cherry, elm, and poplar.

Ernest silt loam is a rather uncertain soil, but where good drainage has been established it is a fertile soil for the production of grass and grain. The best yields are made in dry seasons, and the soil can withstand prolonged periods of drought.

The reported acre yields of corn range from 15 to 40 bushels, oats 20 to 40 bushels, wheat 15 to 25 bushels, rye 12 to 30 bushels, and hay 1 to 2 tons. An extensive truck farm is located on this soil, and much success has been attained with cabbage, tomatoes, broccoli, carrots, spinach, potatoes, lettuce, beets, cauliflower, onions, eggplant, and horseradish. The soil contains a fair quantity of organic matter but is very acid in reaction. Lime is applied frequently and in large quantities to improve the chemical and physical condition of the soil.

Ernest silt loam, calcareous phase.—The 10-inch surface soil of the calcareous phase of Ernest silt loam is heavy mellow silt loam. It is rather abruptly underlain by heavy silty clay of blocky structure, intricately mottled yellow, gray, and brown. Below a depth of 20 inches and extending to a depth of 35 or more inches, the silty clay is slightly heavier in texture and the general color is darker, but the gray and yellow mottles persist. Between depths of 35 and 50

inches the material becomes somewhat lighter in texture but more compact, indurated, and brittle in structure, and generally lighter in color, that is, mottled gray, yellow, and brown. This layer is called a hardpan, and it varies in thickness. In most places it is separated from the underlying bedrock of shale or sandy shale by a layer of sandy loam or silt loam. Locally the soil mass contains many small sandstone and shale fragments. This is one of the deeper soils of the county and consists in part of an accumulation of material washed from the higher slopes.

The calcareous phase of Ernest silt loam is one of the less extensive soils. It occurs in the vicinity of Indiana, west of Homer City, northwest and southwest of Smathers, near Kent, south of Shelocta, and in other places throughout the southwestern part of the county. It occupies the lower slopes bordering the streams, and in most places the surface relief is good, which allows ready run-off of surplus water. However, in many places water intermittently seeps out over the surface. In cuts, particularly during wet periods, water seeps out above the hardpan almost continually, and little of it appears to penetrate the compact material.

About 90 percent of the land has been cleared, and the rest is included in wood lots or very small acreages of timber and brush, which consist largely of a mixed growth of various large oaks, maple, poplar, butternut, dogwood, and locust.

The cultivated areas are used for growing corn, oats, wheat, rye, hay, and pasture. Corn occupies about 15 percent, oats 17 percent, wheat 6 percent, and rye 5 percent of the crop land, and the rest is in hay and pasture. The acre yields of corn range from 35 to 50 bushels, oats 20 to 40 bushels, wheat 15 to 40 bushels, rye 12 to 35 bushels, and hay 1 to 2 tons.

This is said to be one of the most fertile soils in the county for the production of grass and grain, although some difficulty is had in getting a stand of wheat and rye, as these crops are said to winterkill easily in some places. The pastures are reported as excellent, and they last for long periods.

The calcareous phase of Ernest silt loam has a good supply of organic matter, and the soil ranges from slightly acid to alkaline in reaction, as it is influenced by the higher lying limestone soils. It is an easy soil to work, and all kinds of labor-saving machinery can be utilized, so that crops can be economically produced. Crops do not thrive well in extremely wet years. Drainage is necessary in many places.

Monongahela silt loam.—The 12-inch surface soil of Monongahela silt loam consists of mellow brown silt loam. It is underlain by yellowish-brown light silty clay which becomes heavier with depth and, at a depth of about 24 inches, rests on yellow silty clay or fine sandy clay, mottled faintly with gray and brown. This layer may extend beyond a depth of 3 feet, where it rests on a darker colored layer which in most places is indurated and brittle, mottled with gray and brown, and generally fine sandy clay in texture. This layer may range from 12 inches to 2 feet in thickness, and it rests on sand, sandy loam, or gritty loam, with or without water-worn gravel.

Areas of this soil occur near the rivers and larger streams, and they occupy the second bottoms or terraces lying from 5 to 20 feet above the first bottoms or overflow land. The surface relief ranges from flat to gently sloping. The land is fairly well drained in most places, but water frequently remains on the flatter surfaces after heavy rains, and the soil may become saturated just above the hardpan layer.

Areas of this soil occur in the vicinities of Robinson, Blairsville, North Point, Tunnelton, and Saltsburg, east of Shelocta, and around Homer City.

Included with Monongahela silt loam and associated with the higher areas are a few eroded spots. One such area occurs north of Saltsburg. Here erosion of the typical soil on the steeper slopes has exposed material somewhat like Upshur clay loam, with more or less rounded gravel over the surface. Another body occurs on the slopes near Tunnelton, but the soil here is more like Rayne cobbly silt loam. The stone fragments are more like cobbles than flaggy stone fragments. In bodies of this character occurring on slopes, erosion is apt to expose different kinds of geologic or parent material.

Probably 90 percent of Monongahela silt loam is cleared, and the rest supports a mixed tree growth of various large oaks, hickory, maple, poplar, beech, and wild cherry. The cultivated land is used for the production of corn, oats, and hay. Wheat and rye are said to winter-kill easily, particularly where the soil is imperfectly drained. Acre yields of corn range from 20 to 40 bushels, wheat from 15 to 25 bushels, rye from 12 to 30 bushels, oats from 35 to 50 bushels, potatoes from 50 to 150 bushels, and hay from 1 to 2 tons. Alfalfa yields are light, ranging from only three-fourths to 1 ton an acre. Garden vegetables are said to do well.

Monongahela silt loam contains only a fair amount of organic matter in the surface soil, and the soil is generally acid throughout. It is an easy soil to work, and crops can be economically grown, as the surface relief is such that all kinds of labor-saving machinery can be used.

Pope silt loam.—Pope silt loam has a brown or dark-brown mellow silt loam surface soil extending to a depth ranging from 12 to 15 inches, where it is, in general, underlain by yellowish-brown heavy silt loam or light silty clay, which, at a depth of about 24 inches, passes into yellowish-brown heavy silty clay or fine sandy clay, conspicuously mottled with gray and rust brown. This layer may be 2 feet thick, and it rests on sand, sandy loam, or gritty loam, with or without washed gravel. This lower material is nearly always saturated, unless the season is very dry.

Pope silt loam occurs on the first, or overflow, bottoms of the rivers and streams, mainly where the outwashed material consisted largely of shales and sandstones, and it shows no limestone influence. It occupies flat or gently sloping areas above the watercourses and is subject to frequent inundation. Most of the land is cleared, as flat land is considered a desirable addition to the farms of this section. The principal crops grown are corn, oats, hay, and pasture. The acre yields of corn range from 40 to 60 bushels, oats 30 to 50

bushels, and hay 1 to 2 tons. Timothy and clover pastures are said to last from 3 to 7 years. All crops do best in dry years.

This is a more or less uncertain soil, on account of possible overflow, and it is not uncommon for the corn to be harvested early and removed to higher land when there is danger of floods.

As on the Monongahela soils, crops can be produced more economically on Pope silt loam than on land of less favorable surface relief. Farmers state that the value of this land could be materially increased if the streams were deepened and straightened.

Included with Pope silt loam in mapping are areas which consist of chocolate-brown silt loam to a depth of 12 or 15 inches. This material passes into lighter colored silty clay loam or silty clay, which in few places extends below a depth of 20 inches, where it rests on yellowish-brown silty clay or fine sandy clay mottled with gray and yellow, and this, in turn, rests on stream wash within a depth of 30 inches. In local spots, particularly near the watercourses, the heavy layer is absent. The mottled layer is in most places wet or saturated unless the season is unusually dry. These included areas are very small, and they occur only in the southwestern part of the county where the outwash material is slightly influenced by limestone. Most of the land is used as pasture, but excellent crops of corn, oats, and hay are grown under favorable conditions. The surface soil contains a good supply of organic matter and ranges from slightly acid to alkaline in reaction. The pastures on these areas are said to be strong and very persistent.

Pope loam.—Pope loam is similar to Pope silt loam, with the exception that the surface soil and subsurface soil are lighter in texture and contain a greater proportion of loam or fine sandy loam. Where both Pope loam and Pope silt loam occur in the bottoms, the loam is more likely to lie nearer the watercourses, occupying a higher position and forming a natural levee. In this position it is said to be somewhat more dependable for crops, but yields are not so heavy. This land is used for the same crops as Pope silt loam, but its use is restricted on account of possible overflows.

POORLY DRAINED SOILS

Included in the group of poorly drained soils are members of the Lickdale, Atkins, and Robertsville series, and alluvial soils, undifferentiated. This group is small in extent, having an aggregate area of 37.8 square miles. Members of this group occur in all parts of the county, occupying flat or sloping surfaces, and they range from imperfectly drained to saturated, or a nearly swamp condition.

Most of these soils are covered with timber or brush, which has been removed in places, generally for the value of the timber rather than to prepare the land for cropping. In places some effort has been made to reclaim some of these lands by the use of tile and open ditches, and some success has been attained.

Most of these soils have a very restricted agricultural value, as they are generally too wet or uncertain. Most of them have no value for field crops, but some areas afford good pasture for livestock.

Lickdale silt loam.—Lickdale silt loam consists of grayish-brown silt or heavy silt loam, mottled with gray, yellowish brown, or red-

dish brown, underlain by grayish-yellow silty clay mottled with yellow and brown, which may extend to a depth of about 15 inches where it passes into heavy silty clay mottled with gray and yellow. This material extends to a depth of 36 or more inches and is generally saturated.

Lickdale silt loam is one of the less extensive soils of the county and is restricted largely to the eastern part. It occurs near Johnsonburg, Canoeridge, east and south of Cookport, near Pine Flats, and around Strongstown. Most of it is at the heads of streams, in more or less depressed areas. Nearly all the land is saturated most of the time and supports a vegetation of sedges, cattails, and other water-loving plants. Beech, maple, and oak trees are conspicuous on the better drained land on the edges of depressions. This soil has no present agricultural value other than some pasture for livestock.

Robertsville silt loam.—The 8-inch surface soil of Robertsville silt loam consists of dark-brown or almost black mellow silt loam faintly mottled with gray, rust brown, and black. This material passes gradually into mottled yellow, gray, and brown light silty clay which in most places extends to a depth of more than 3 feet and in many places is saturated with water. In most places this material is underlain by a darker layer of lighter texture, consisting of brown sandy or gritty loam mottled with gray and yellow, and it has the characteristics of a well-developed hardpan, as the material is indurated and brittle and has no definite cleavage. This layer ranges in thickness from 12 to 24 inches and rests on sand or sandy loam.

This is one of the less extensive soils of the county. It occurs north and west of Blacklick, northeast of Tunnelton, east of Fillmore, and northwest of Blairsville. It occupies flat or sloping areas on the second bottoms along the rivers and larger streams. Drainage is not well established, except locally where artificial drainage has been effected by opening surface ditches and by the use of tile. Where artificial drainage is established, the soil is considered good for general farm crops, and the surface relief is favorable for the use of labor-saving machinery.

About 60 percent of the land is cleared, and the rest is in timber and brush. The tree growth consists of various oaks, hickory, maple, wild cherry, beech, ash, elm, and sycamore. In the best situations some corn, oats, and hay are grown, and the acre yields of corn range from 25 to 40 bushels, oats 15 to 35 bushels, and hay one-half to 1½ tons. The surface soil has a fair content of organic matter, but it is acid in reaction.

Atkins silt loam.—The 10-inch surface soil of Atkins silt loam consists of grayish-brown or dark-brown silt loam faintly mottled with yellow and rust brown. In most places this is underlain by yellow light silty clay containing more distinct mottles of gray and brown. This layer gradually becomes heavier with depth, and, at a depth of about 20 inches, is heavy yellow silty clay mottled with gray, pale yellow, and brown. This material does not change appreciably in texture with depth, but the gray color is more pronounced near the base of the soil mass, which terminates in most places at a depth ranging from 24 to 40 inches and is underlain by bedrock or stream wash.

Mapped areas of this soil include spots where the soil material is darker, one of the largest of these occurring 2 miles southwest of Warner Hill. It also includes local spots of stony silt loam, one of the largest lying northeast of Huff.

Atkins silt loam is one of the less extensive soils. It occurs near Blacklick, north of Fillmore, and near Homer City. It occupies the first bottoms of streams. The surface relief is flat or slightly inclined toward the stream channel. The land is elevated slightly above the normal elevation of the stream and is subject to frequent overflow.

More than half of the land has been cleared, and the rest supports a mixed growth of oak, hickory, ironwood, wild cherry, maple, haw, ash, and sycamore.

Little of this land is utilized for crops, other than an occasional corn crop in more favored situations. Most of it is used as pasture land.

Alluvial soils, undifferentiated.—Alluvial soils, undifferentiated, represent a soil condition rather than a soil type. This material consists of undifferentiated soil material along the smaller streams and branches and includes stream wash consisting of sand, sandy loam, or gritty loam, with or without gravel, or it may be shallow sandy loam or silt loam resting on a lighter colored heavier layer, and this, in turn, being underlain by stream wash.

This undifferentiated soil occurs in all parts of the county in very narrow strips. It occupies flat or slightly sloping areas adjacent to the watercourses and just above the water. It is subject to frequent overflow, and for this reason is not a dependable soil for the production of crops. It does, however, afford good pasture at times.

AGRICULTURAL METHODS AND MANAGEMENT[3]

The agricultural methods and management in Indiana County are characteristic of a section where the agriculture consists of general and dairy farming, but it is restricted to those crops suited to the geographical position and to the climatic conditions.

As has been noted in the section on Agricultural History and Statistics, the methods of farming changed considerably when the mules and horses used in the mines were replaced by electric power. Agriculture is still in a transitional stage, but the dairy interests are gradually dominating the situation and general farming has become a complement to dairy farming rather than a separate interest.

The demands for hay and feed by the mine owners developed an intensive production of grain and hay. The rotation periods were lengthened, more grain crops were produced, and the hay meadows were run 2 or 3 years. It was a general practice of exploitation rather than conservation, and the productivity of the soils was greatly impaired. Hay was formerly shipped out in large quantities, but the hay market has been very unsatisfactory during the last 5 years, and the reduced demand now has caused the farmers to mow their meadows only 1 year.

The crop rotations practiced are somewhat variable and range from 3 to 5 years. A common 3-year rotation is corn, oats or barley, and

[3] The information in this section was contributed by J. W. Warner, county agent.

clover. Another common practice is for wheat or rye to follow oats, used as a nurse crop for timothy and clover, and hay produced for 1 or 2 years. If potatoes are grown, they usually take the place of corn in the rotation. Oats are sown in the spring and wheat in the fall. Buckwheat is sometimes included in the rotation and is followed by wheat or rye sown in the buckwheat stubble without plowing. Alfalfa is grown in combination with sweetclover and other clovers with timothy, as it seems to endure the winter better when seeded with clover. It is seeded in the spring at the same time that red clover is sown. A number of farmers are growing soybeans for forage and feeding the hay to horses, cattle, sheep, and poultry. Practically none of this crop is grown for seed. Inoculation is generally practiced for alfalfa, sweetclover, soybeans, and hairy vetch.

Corn is the most important cultivated crop and is produced for silage and grain on all soils. Where grown for grain very little of the crop is shocked, but the tops are removed in the field and the corn left standing until husking time. The silage corn is cut and removed from the field. Particular attention is given by the farmers to the selection of seed corn. This is made in the field from standing stalks, in order to obtain seed free from root rot or degenerative disease, as corn root rot is responsible for a heavy loss in germination, blank stalks, and undeveloped ears. When selected, the ears are hung in well-ventilated buildings, where each ear has an opportunity to thoroughly dry before freezing weather.

Oats occupy the largest acreage of the small grains, but there is a tendency to substitute some of the oat acreage with barley, although barley is still of minor importance. Most of the oats are consumed on the farm where grown, as this crop is the basis of all feed rations. Oat straw is used for bedding and is fed to some extent.

Wheat occupies an important place in the crop rotation.

Buckwheat is an important cash crop and is used either in the rotation or as a catch crop. It is generally planted on the light or less productive soils. Most of the buckwheat is sold from the farms, but a small quantity is used in cattle rations. This is a suitable crop on many farms, as seeding is done at a time of year when other work is not pressing, that is, about the first week in July, and the crop is harvested about the first week in September. Most farmers make an acre application of about 125 pounds of 16- or 20-percent superphosphate at the time of seeding.

Rye is an important crop which is sometimes substituted for wheat, particularly where the yields are heavier. Rye is an important constituent in the rations for hogs, and a few farmers use a little rye in the dairy ration. The straw furnishes excellent bedding. Some farmers plow under rye before planting the land to potatoes and celery, and others are growing a combination of hairy vetch and rye, which is cut for hay or left to ripen for threshing.

The acreage of potatoes is being gradually extended, and potatoes are becoming an important cash crop. Modern methods of potato growing are employed. The ground is prepared by plowing under sweetclover, clover sod, or soybeans; making a heavy application of complete fertilizer; using disease-free seed; using the weeder and less cultivation; and using power sprayers and power diggers.

Many farmers are building underground storage cellars, in order to supply the market with potatoes more continuously.

The production of cabbage, although small at present, promises to be greatly increased. This crop is usually planted after a leguminous crop, and it is heavily fertilized and manured.

Market-garden crops of sweet corn, tomatoes, celery, carrots, broccoli, spinach, head lettuce, beets, cauliflower, eggplant, and onions are mainly of local importance, although large quantities of tomatoes are shipped.

Much more attention is now being given to permanent pastures, particularly by the dairy farmers. Pastures are being seeded following applications of lime and superphosphate, usually on land not so well adapted to crop farming, on account of surface relief, stream channels, or irregularly shaped fields. The seed mixtures for pastures generally include Kentucky bluegrass, timothy, redtop, sweetclover, red clover, alsike clover, and white clover. The pastures are seeded to grass alone or with a nurse crop of oats or barley. Another type of pasture improvement is that of top dressing old permanent pastures with lime, superphosphate, and applications of barnyard manure, but very little highly concentrated complete fertilizer has been used. Cattle are frequently changed from one pasture to another.

Apples are the dominant fruit, and much more interest than formerly is taken in the care and attention of the orchards. Modern spraying methods are now being used, and a considerable quantity of clean fruit is produced. Some farmers use cold storage, but most of the apples are put in natural storage. Fruit of the poorer grades is made into cider and vinegar.

Peaches are not dependable, but some of the hardy varieties make profitable crops every 2 or 3 years. Plums, pears, and cherries are grown largely for home use, and very few grapes are grown, except for home use. Strawberries, raspberries, and blackberries are grown in home gardens.

The county contains a considerable acreage of marginal land which is too steep, shallow, or poorly drained to be farmed economically or profitably, although some of it is farmed occasionally. One coal company has planted 4,000 acres of such land to coniferous trees, mainly Scotch pine. A number of farmers, also, have begun to plant their idle acres to evergreen seedlings, and one corporation has embarked in the Christmas-tree business and now has 600 acres planted to this crop. In 1931, 14 carloads of trees were shipped. It is expected that in the future seedlings of forest trees will be planted on thousands of acres of idle land.

The change to more intensive dairy farming is doing much to improve the productiveness of the soil. Farmers now not only feed practically all the roughage and grain produced on the farms but buy a large quantity of prepared dairy feeds and concentrates, such as oil meal, cottonseed meal, and gluten feed. Through the manure these concentrates add considerably to soil fertility.

The increasing use of leguminous forage for dairy cows has made the use of lime on the soils a more common practice. Much of the lime is obtained from the many local sources throughout the county, although much of it is not of high quality. It is usually prepared by building up rectangular heaps with alternating beds of coal and

limestone and the mass fired. The use of coal is said to be cheaper than wood for this purpose. Most of the better grade of lime is obtained from sources in Center, Blair, and Butler Counties. This is purchased as pulverized limestone, burnt lime, hydrated lime, and byproduct lime. More and more farmers are submitting soil samples to the county agent for analysis as to their lime requirements. Especially is this a practice of farmers who grow alfalfa and sweetclover for permanent meadows. Lime is usually applied once in the rotation, usually before seeding to a legume.

The following recommendations for the use of lime are given in Bulletin 211 of the Pennsylvania Agricultural Experiment Station:[3]

> These studies indicate the economy in applying moderate amounts of lime at intervals of 3 to 5 years rather than using very heavy applications with the expectation of greatly lengthening the intervals. Lime is lost from the soil by leaching and by removal of crops. The legumes, such as clover and alfalfa, are not only less tolerant of soil acidity than the cereals, but they require also more lime for healthy growth and remove more from the soil than do the cereals. It is, therefore, important to make the applications of lime just preceding the seeding of the legumes. Where clover is seeded on winter wheat, a common practice in Pennsylvania, the lime should be applied to the plowed land a short time in advance of seeding the wheat. This brings it into action and promotes the catch and growth of clover.
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> The studies reported in this bulletin substantiate earlier studies on lime that have been in progress at the Experiment Station for 20 years and emphasize the importance of applying lime to the soil whenever it becomes a limiting factor in crop production. These tests all indicate that it makes little difference what form of lime is used as long as it is moderately well pulverized and evenly mixed with the surface soil. We advise using the form of lime that can be put on the land at the lowest cost per unit of active material, taking into account the convenience and economy of spreading as determined by the form and the machinery available for distributing it.

Farmers throughout the county recognize the need of applying mineral fertilizer as a supplement to manure. On most of the field crops, especially corn, oats, wheat, rye, and buckwheat, superphosphate is generally used in acre applications ranging from 100 to 300 pounds. This is the recommendation of the experiment station, where a system of livestock farming is practiced. The up-to-date potato grower is using an acre application ranging from 800 to 1,000 pounds of a 4–8–7[4] fertilizer in the rows in addition to plowing down a 1-year's growth of sweetclover, red clover, or soybeans. Different fertilizer mixtures are used for the different truck crops, and the quantities of the acre applications differ considerably. For sweet corn about 300 pounds of a 3–10–6 mixture is applied, celery receives from 500 to 600 pounds of 7–8–7, tomatoes about 500 pounds of 3–10–6, and cabbage, horseradish, carrots, beets, spinach, broccoli, lettuce, cauliflower, onions, and eggplant from 200 to 500 pounds of 7–12–7. Some farmers apply 150 pounds of 2–8–10, or the same quantity of superphosphate. For oats, 200 pounds of 2–12–2 or from 100 to 300 pounds of superphosphate are used and for potatoes from 500 to 1,000 pounds of 4–8–7.

In another State experiment station bulletin[5] is a description of fertilizer experiments on Dekalb soil, on yields of clover, corn, and

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[3] WHITE, J. W., and HOLBEN, F. J. ECONOMIC VALUES OF DIFFERENT FORMS AND AMOUNTS OF AGRICUTURAL LIME. Pa. Agr. Expt. Sta. Bull. 211, 23 pp., illus. 1927.

[4] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

[5] WHITE, J. W. FERTILIZER EXPERIMENTS ON DEKALB SOIL. YIELDS OF CLOVER, CORN AND KENTUCKY BLUE GRASS. Pa. Agr. Expt. Sta. Bull. 155, 20 pp., illus. 1919.

Kentucky bluegrass. The results show the value of the increased yields of hay and corn to be in excess of the fertilizer cost.

Still another State experiment station bulletin [6] sets forth the soil-fertility experiments on the Volusia and Westmoreland soils. The results of the experiments on the Westmoreland soils have a direct bearing on soils which occur in Indiana County and are of particular interest to the farmers in the southwestern part.

The tendency of the agriculture of this county seems to be toward more intensive farming, especially dairying, market gardening, the production of poultry and poultry products, the more extensive development of apple orchards, and the production of cane fruits. At present, less marginal and submarginal land is used, and the farmers are using land with the more favorable surface relief, where crops can be more economically grown and all kinds of labor-saving machinery can be used.

SOILS AND THEIR INTERPRETATION

Indiana County is included in the Allegheny Plateau section of Pennsylvania and lies on the boundary between the regions of the Gray-Brown Podzolic soils and the Podzol soils. Approximately one-half of the county lies in one soil region and one-half in the other. The Podzol region is in the eastern half, and the Gray-Brown Podzolic region in the western half. The line between these two regions is clear-cut in the southern two-thirds of its length. In the northern part of the county, however, the Podzol soils occur in scattered areas in the northwest.

The soils have developed under forest cover and climatic conditions which give opportunity for the development of a conspicuous layer of organic matter, ranging from 1 to 3 inches in thickness, on the surface of the Podzol soils where the soils have not been disturbed. Here the organic matter is dark brown, is partly decomposed, and is penetrated by innumerable fibers of living tissue to the extent that most of it can be rolled up like a mat. Under cultivation the organic matter does not persist for long periods. On soils of the Gray-Brown Podzolic group the organic matter is entirely different. In undisturbed places the surface is usually covered with forest litter, under which is a compacted layer of leaves, twigs, and other debris, which are less distinguishable and more nearly decomposed as the mineral soil is approached. Unlike the Podzol soils, the color of the mineral soil is influenced to a depth of about 3 inches by intermingling of organic matter, giving the soil a dark-brown color. The organic layer appears to last longer on these soils after cultivation than on the Podzol soils.

The differences in the character and amount of organic matter in the soils of the two regions is attributed to local variations in the climate. The Podzol soils reflect one regional condition and the Gray-Brown Podzolic soils another. The Podzol soils occupy a higher altitude, the periods of freezing are more prolonged, the tree growth is heavier, the rainfall is heavier, snow remains on the

[6] WHITE, J. W., and GARDNER, F. D. SOIL FERTILITY EXPERIMENTS ON VOLUSIA AND WESTMORELAND SOILS. Pa. Agr. Expt. Sta. Bull. 229, 31 pp., illus. 1928.

surface longer, and fogs are more common and seem to concentrate on the westward-facing slopes.

The character of the forest growth, already discussed in the opening section of this report, is in some measure responsible for the character of the organic material covering the soils.

Indiana County has been greatly dissected by geologic erosion. The eastern plateau or Podzol belt ranges in general from 1,500 feet to 1,900 feet above sea level, and the western low plateau or Gray-Brown Podzolic belt, from 1,200 to 1,500 feet, with the highest elevations in the eastern and northern parts. Stream dissection in the eastern and northern parts has not been so extensive, and some broad upland areas still remain in places, whereas, in the western part reduction has been more complete, and the uplands are only trailing divides and narrow ridges. In the eastern part soil processes have attained a development not possible in the western part, where run-off has been more rapid and less water is available for plant growth, and subsequent soil development and erosion remove the soil material almost as rapidly as it forms.

The rocks exposed in this county, responsible to some extent within the soil zones for the distribution of the soils, belong to the Pennsylvania division of the Carboniferous system. The lowest formation is the Pottsville, which consists of sandstones separated by beds of shale which, in places, include layers of coal. This formation occurs principally on the lower western slopes of Chestnut Ridge and along Allen Run. It does not contribute much of the parent material as it occupies steep slopes.

The Allegheny formation, which occurs above the Pottsville, has a wider distribution but still is of minor importance as regards parent material. This formation is found on the western slope of Chestnut Ridge and in the lower valleys in the southwestern part of the county. It is extremely variable in composition, consisting of shales, sandstone, a few thin seams of limestone, and a number of layers of coal. Members of the gray soils group and of the chocolate-brown soils group are developed from this formation. In the region of the gray soils group it occurs on slopes where mature development is hardly possible. Where this formation occurs in the region of the chocolate-brown soils, the parent material is more affected by inclusions of thin layers of limestone, and the occurrence of limestone ledges in overlying formations has contributed to modification of the parent material.

The Conemaugh formation overlies the Allegheny and is exposed in all parts of the county. It occupied the surface of most of the county, and weathering of these rocks has produced the greater part of the material from which the soils have been derived. This formation is composed mainly of gray, drab, and red shales but includes occasional beds of sandstone, limestone, and coal. The sandstones are buff or white, and they range from fine-textured to coarse iron-stained sandstone, with local development of conglomerate in places. This formation has contributed the parent material for most of the soils in the Gray-Brown Podzolic soils group, and to a more limited extent those in the chocolate-brown soils group.

It is of course recognized that parent or geologic material produced through the weathering of rocks does not constitute soil, but

that soils are developed under soil-forming processes conditioned by climate, vegetation, and relief; and that soils attain a regional development in undisturbed sections only with time. The soils of the Podzol region are grouped into true, or gray, Podzols and brown Podzols. The Gray-Brown Podzolic soils are divided into gray-brown and chocolate-brown soils, based on color due to parent material. There are hardpan soils, claypan soils, and alluvial soils in both regions. The hardpan soils are developed under a high water table, the claypan soils from heavy parent materials, and the alluvial soils are deposited, with little alteration by soil-forming processes. The colors of all soils described here are those occurring under undisturbed forest conditions and not in cultivated fields.

The true Podzols containing a gray horizon are restricted mainly to the eastern part of the county, although such soils have developed locally in the northwestern part, the strongest Podzol development being confined to the more sandy material. This is a minor subgroup as regards distribution. These soils have a characteristic profile consisting of (1) a definite layer of raw humus, underlain by (2) a gray or leached horizon, and (3) a brown zone of concentration. These gray and brown layers, although thin in this region, are distinct. The brown Podzols restricted to the eastern part of the county are more extensive than the true Podzols. They also have a greater range in surface relief. These soils contain a well-developed layer of raw humus, but the gray layer is incipient; although in the light-textured soils or those having some sand in the surface soil, many individual grains stand out conspicuously and show evidences of true Podzol formation. In general, the heavy soils, such as the Cavode, are not true Podzols. The Cookport soils, which in places have a better defined Podzol layer than some of the lighter soils, have a true hardpan developed.

The Gray-Brown Podzolic soils occur in the western part of the county and are divided into two subgroups: (1) Gray-brown soils, derived from calcareous material, and (2) chocolate-brown soils from noncalcareous material. The chocolate-brown soils occur in the southwestern part and the gray-brown in the northwestern part.

The greater rainfall on the westward-exposed slopes of the eastern plateau, together with a difference in temperature, is enough to account for the differences in vegetation and organic matter, and it may be assumed that the climate has had a stronger influence in the development of the soils than the parent material. In the western part where the country is greatly dissected and the soils are younger, the climate has not made the same impression. Here the soils have inherited a great deal of their character from the parent material.

The hardpan soils occur mainly in the higher, smoother parts of the county, and although they have been influenced to some degree by climatic conditions, the hardpan has been developed under a high ground water table. Included with this division is a small group of claypan soils which occur in all parts of the county and are due mainly to the clayey parent material, on which the climate has had little effect.

The alluvial soils border the rivers and streams in all parts of the county and represent low terraces and present overflow bottoms. These soils are subdivided according to differences of parent material and drainage.

Indiana County includes some soils that are very old and many that are relatively very young. The older soils are restricted to the tops of the plateaus and some of the higher and older terraces, which are little affected by geologic erosion. Some are classed as postmature soils. Other soils, although not so old, have reached a mature stage of development. The mature or well-developed soils, which may be considered representative of the region, are soils of the Leetonia, Clymer, and Rayne series. They have the threefold arrangement that characterizes maturity of the normal soil. All have a relatively light textured A horizon, a much heavier textured B horizon of uniform color, texture, and structure, and a C horizon lighter in texture and variable in thickness and color, in some places consisting of unconsolidated shale and sandy shale fragments intermixed with fine material. In all the normally developed soils, considerable eluviation has taken place in the A horizon, and a large proportion of the original fine material has been carried to the B horizon or removed by later movement of water. For this reason the B horizon is heavier than the layer above.

In addition to the large group of soils that have normal profiles, there is an extensive group of young soils. The young soils show a closer relationship to parent material than the mature soils. They are undeveloped because erosion does not allow soil material to accumulate. These soils may have a well-developed A horizon which rests directly on unconsolidated rock or they may have a very shallow B horizon or only a slight indication of a B horizon. These soils are members of the Dekalb and Gilpin series. In addition to these soils, others, such as Lickdale silt loam, the poorly drained phase of Cookport silt loam, Robertsville silt loam, and Atkins silt loam, have not developed normal profiles because the water table is too close to the surface.

The soils derived from calcareous material are also considered young soils, as they have not developed mature profiles. The soils of this class are the Upshur, Westmoreland, Belmont, Ernest, and Brooke soils. The Ernest soils are subject to sidehill seepage.

The profiles of the postmature soils are characterized by a well-developed hardpan. The induration and cementation of this layer is attributed to gravitational waters impregnated with iron or other minerals, and they possibly carry also some fine material or colloids and have probably developed under a fluctuating water table. The Cookport soils of the uplands and the Monongahela soils of the terraces belong to this group and represent some of the oldest soils in the county.

The bottoms and low terraces along the rivers and streams represent the more recent alluvium. These soils are too young to have developed profiles. The outwash material came from sandstones and shales and to a small extent from calcareous rocks. The group is represented by the Pope, Atkins, and undifferentiated alluvial soils.

To give an idea of the soils of the county, descriptions of a few profiles observed at definite locations are given. They include some soils that have attained normal development and others that have not. Comparisons and relations of the different soils are described in more or less detail.

Following is a description of a profile of Leetonia gravelly sandy loam, one of the true Podzol soils, located 2½ miles west of Sidney:

A_0 and A_1. 0 to 3 inches, raw humus, with scattered leaves and small branches over the surface. The humus is dark brown, matlike, and thickly penetrated with roots of wintergreen, or teaberry.
A_2. 3 to 5 inches, gray compact sand with living roots of wintergreen. This is the bleicherde, or leached zone.
B_1. 5 to 5½ inches, brown compact sandy loam containing small root fibers. This is the orterde, or zone of accumulation.
B_2. 5½ to 9½ inches, heavy yellow sandy loam of granular structure.
B_3. 9½ to 15 inches, yellow light sandy loam of granular structure.
C_1. 15 to 30 inches, dark-yellow loamy sand.
C_2. 30 to 48 inches, dark-yellow sand.
D. 48 inches+, bedrock of gray sandstone.

The Dekalb soils differ essentially from the Leetonia in the absence of a well-defined gray layer, or bleicherde, and a brown indurated layer, or ortstein, although they have the same covering of mat humus (raw humus) and some evidence of leaching in the occasional clear sand grains. Fragmentary rock in the surface soil is generally lighter in color than rocks in other layers and has a bleached appearance. These soils are weakly developed Podzols, and they are more closely related to the Leetonia soils than to soils of other groups.

The Clymer soils have in general the same relationship to the Leetonia soils as the Dekalb, but they have deeper, heavier, and more compact B horizons. Members of this group in other sections of the Allegheny Plateau region have been mapped as Dekalb.

The Rayne soils are the only normally developed soils in the northwestern part of the county. They belong to the Gray-Brown Podzolic soils group and lack the matlike humus layer characteristic of the Podzols. These soils have deep well-developed B horizons, are derived from noncalcareous material, and are generally acid in reaction. They also belong to the brown soils subgroup.

Following is a description of a profile of Rayne gravelly silt loam, located 3 miles north of Indiana:

A_{00}. 0 to ½ inch, leaf and forest debris.
A_0. ½ to 1 inch, black leaf mold, with some silt loam.
A_1. 1 to 2 inches, grayish-brown mellow silt loam, with some organic matter and small sandstone fragments.
A_2. 2 to 10 inches, pale yellowish-brown or tan silt loam which is more compact than the material in the layer above.
B. 10 to 30 inches, buff or yellowish-brown compact silty clay loam or light silty clay. The material breaks up in small irregular checks and includes shale and sandstone fragments.
C. 30 to 60 inches, unconsolidated shales, between which is brown loam much darker than the fine material in the layer above and more like the surface soil.

The Gilpin soils are closely associated with the Rayne soils and represent the dominant soil of this group. They are young soils which, on account of their steeper relief, have not attained maturity and might be considered in general as shallow phases of the Rayne soils. These soils are acid, and the parent material is noncalcareous.

Following is a description of a profile of Gilpin gravelly silt loam, as observed 4 miles west of Indiana:

A_0. 0 to ½ inch, leaf and forest litter, with slight indications of leaf mold. The surface is covered with platy sandy shale.

A_1. ½ to 3½ inches, dark-brown or almost black silt loam, with crumblike or rather open structure. Sandy shale fragments are on the surface and throughout this layer.
A_2. 3½ to 5 inches, grayish-brown silt loam less open in structure than the silt loam layer above. Sandy shale fragments are on the surface and through this layer.
B. 5 to 8 inches, yellow light silty clay or heavy silty loam.
C_1. 8 to 13 inches, unconsolidated sandy shale intermixed with dark-brown silt loam.
C_2. 13 inches+, unconsolidated sandy shale with less brown silt between the rock fragments.

Following is a description of a profile of Upshur silt loam, observed 2¼ miles northeast of Indiana:

A_1. 0 to 2 inches, dark-brown silt loam mixed with organic matter.
A_{11}. 2 to 5 inches, dark-brown mellow silt loam.
A_2. 5 to 12 inches, compact light grayish-brown silt loam tinged with red.
B_2. 12 to 24 inches, brown silty clay penetrated by occasional root channels. The material in an exposed bank breaks into small irregular checks.
B_{21}. 24 to 42 inches, reddish-brown heavy plastic clay which dries out in small irregular checks in an exposed bank.
C. 42 to 50 inches, reddish-brown heavy clay splotched with gray, yellow, and purple. The material contains some small shale fragments.
D. 50 inches+, dark-red shale.

The profile just described is that of one of the best developed soils of the calcareous group. The parent, or geologic, material is largely red shale, with interbedded limestone. The soils range from slightly acid to alkaline in reaction. The influence of the parent material is still seen in the color which as yet has not been leached out.

The Brooke soils are essentially different from the Upshur in the character of the parent material which is dark-colored massive limestone. These soils in general are more shallow, the surface layers are usually heavier in texture and lighter in color than the Upshur, and the B horizon is more olive, or brown, and is more uniform in color.

The Westmoreland soils are the most variable of the calcareous soils group. The parent material may be gray or yellow shales interbedded with limestone or calcareous shales. The soils may contain no calcareous material whatever but are influenced by outwash from Brooke or Westmoreland soils lying contiguous to or above them. The Westmoreland soils range from very acid to alkaline in reaction.

SUMMARY

Indiana County is in the west-central part of Pennsylvania. It lies in the Allegheny Plateau section and is characterized by a series of longitudinal ridges and valleys which merge toward the north. The ridges attain their maximum elevation in the eastern part of the county and are successively lower as they extend westward. The elevation of the county as a whole ranges from less than 900 feet to more than 2,000 feet above sea level, and the land presents considerable variation in surface relief.

The climate may be described as continental and characteristic of the North Temperate Zone but lacking in the greatest extremes of this division. The frost-free season includes a period of 147 days which allows the production of a wide range of crops.

Parts of the county have been settled since 1771. The population in 1930 was 75,395, and this county is considered one of the most

progressive counties in the State. It comprises an area of 829 square miles.

The mining of bituminous coal is the principal commercial industry. Dairying and general farming are the dominant agricultural interests. The principal dairy product is whole milk, most of which is transported in tanks and sold in Pittsburgh and other near and remote markets. The principal crops grown are corn, wheat, oats, rye, buckwheat, mixed hay, and forage. These are supplemented by garden truck and fruit. In general the crops grown are those that fit in or best meet the requirements of dairying.

The soils mapped in the county are included in 17 series consisting of 34 soil types and 12 phases, in addition to alluvial soils, undifferentiated, and rough stony land. They have been grouped, for purposes of description, in three general divisions—well-drained soils, imperfectly drained soils, and poorly drained soils. The well-drained soils comprise more than three-fourths of the total area of the county and are subdivided into three groups of upland soils—the chocolate-brown soils, grayish-brown soils, and gray soils. The chocolate-brown soils occur in the southwestern part of the county and have chocolate-brown or dark-brown surface soils and brown or light-brown subsoils. These are the calcareous soils, and they comprise some of the strongest grazing and pasture land in the county. The group includes the Westmoreland, Upshur, Brooke, and Belmont soils.

The grayish-brown soils have grayish-brown surface soils and yellow or light-brown subsoils. They occur in the northwestern part of the county and include the Rayne and Gilpin soils, all of which have a wide range of utilization.

The gray soils have gray or dark-gray surface soils and yellow subsoils. They occur in the eastern half of the county and include much territory that has not been improved. These soils are used mainly for general farming, but in some sections dairy farming is important. They are not considered strong soils but can be developed to a high state of productiveness. They include the Leetonia, Dekalb, and Clymer soils.

The imperfectly drained soils have gray or brown surface soils and yellow or brownish-yellow subsoils. They include the Cookport, Cavode, Ernest, Monongahela, and Pope soils. These soils have restricted utilization on account of imperfect drainage. In places where artificial drainage has been established they represent some of the most productive soils in the county.

The poorly drained soils, including the Lickdale, Atkins, and Robertsville soils, and alluvial soils, undifferentiated, present a greater problem as regards drainage, but even these soils could be materially improved. In the bottom lands, the straightening and deepening of the streamcourses would reclaim considerable land.

The trend in the agriculture seems to be toward more intensive dairy farming, market gardening, poultry production, more extensive growing of orchard and cane fruits, a greater reduction in the utilization of marginal and submarginal land for crop purposes, and a more intensive use of the land suitable for the economic production of crops.

U. S. GOVERNMENT PRINTING OFFICE: 1936

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BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
SOIL SURVEY DIVISION, CHARLES E. KELLOGG, CHIEF

SOIL MAP
INDIANA COUNTY
PENNSYLVANIA

PENNSYLVANIA STATE COLLEGE
SCHOOL OF AGRICULTURE AND EXPERIMENT STATION
R. L. WATTS, DIRECTOR
F. D. GARDNER, HEAD, DEPARTMENT OF AGRONOMY
AUSTIN L. PATRICK, STATE SOIL SURVEY LEADER

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
Secondary roads
Trails and Power lines
Railroads
Steam and Electric
Bridges, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church
Cemeteries
Mine or Quarry
Mine dumps
Made land
Bluff, Escarpment, Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U. S. township and section lines

RELIEF
(Printed in brown or black)

Contours
Depression contours
Prominent Hills
Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

Streams
Lakes, Ponds, Intermittent lake
Intermittent streams
Springs, Canals and Ditches, Flumes
Swamp
Salt marshes
Submerged marsh
Tidal flats

The above signs are in current use on the soil maps, but some of them do not appear in some maps of earlier dates.

LEGEND

Atkins silt loam — As	Dekalb shaly silt loam — Db	Gilpin gravelly sandy loam — Gl	Rayne shaly silt loam — Rn
Belmont silt loam — Bs	Db, Steep phase	Gilpin stony loam — Gs	Rayne stony silt loam — Ry
Brooke silty clay loam — Bc	Dekalb stony silt loam — Dy	Gs, Steep phase	Rayne gravelly silt loam — Rg
Cavode silt loam — Ca	Dy, Steep phase	Letonia stony sandy loam — Ls	Rayne silt loam — Ra
Clymer shaly silt loam — C	Dekalb gravelly silt loam — Do	Ls, Steep phase	Robertsville silt loam — Ro
Clymer stony silt loam — Cs	Do, Steep phase	Letonia gravelly sandy loam — Lg	Upshur silt loam — Us
Clymer gravelly silt loam — Cg	Ernest silt loam — Es	Lg, Steep phase	Us, Steep phase
Clymer silt loam — Cl	Es, Calcareous phase	Lickdale silt loam — Ll	Westmoreland shaly silt loam — Ws
Cookport silt loam — Co	Gilpin shaly silt loam — Gy	Monongahela silt loam — Ms	Westmoreland gravelly silt loam — Wg
Co, Poorly drained phase	Gy, Steep phase	Pope loam — Po	Wg, Steep phase
Dekalb gravelly sandy loam — Dl	Gilpin gravelly silt loam — Gg	Pope silt loam — Pl	Westmoreland silt loam — Wl
Dekalb stony loam — De	Gg, Steep phase	Rough stony land — Rs	Alluvial soils *(Undifferentiated)* — A

W. J. Latimer, Acting Inspector, District 1.
Soils surveyed by R. T. Avon Burke, in charge, and C. S. Simmons, U. S. Department of Agriculture, and J. L. Hosterman, Richard Marshall, and C. H. Atkinson, Pennsylvania State College.

BASE MAP FROM
U. S. GEOLOGICAL SURVEY SHEETS

Scale 1:62,500
1 0 1 2 3 4 Miles
1 0 1 2 3 4 5 Kilometers
Contour interval 20 feet.
Datum is mean sea level.

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Bureau of Chemistry and Soils
1931